U/L

HOUSE OF LORDS

SESSION 2000–01
1st REPORT

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SCIENCE IN SCHOOLS

WITH EVIDENCE

Ordered to be printed 14 March 2001

LONDON : THE STATIONERY OFFICE
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NOTE:

Q. refers to a question in oral evidence; p. refers to a page of written evidence.

FIRST REPORT

14 MARCH 2001

By the Select Committee appointed to consider Science and Technology.

ORDERED TO REPORT

SCIENCE IN SCHOOLS

INTRODUCTION

1. Teachers, like any professional group, need Continuing Professional Development (CPD) – that is, activity beyond initial training, aimed at improving their skills, knowledge and understanding, whether by on-the-job coaching, day-release courses, spare-time study, or any other of the many means available. CPD enables teachers to be better informed about developments in their subject area, to improve their teaching skills and to have greater confidence in the classroom. Good teachers matter more than good courses in inspiring children and stimulating their enthusiasm. CPD is important in all subjects to maintain the knowledge, skills and understanding of teachers and to improve standards in teaching.

2. Science teaching is particularly vital, given that developments in science and technology increasingly influence the whole of society. A healthy democracy needs a public with a broad understanding of major scientific ideas, one that can engage critically with issues and arguments – which involve both scientific knowledge and the limitations of science.[1] Children need to be excited by science at a young age if they are to acquire the "scientific literacy" which we consider to be an essential, but often neglected, part of their education.

3. The purpose of this short Inquiry was to discuss key issues relating to good CPD, and to highlight the particular needs of those who teach science. In particular we wished to influence the thinking behind *Learning and teaching*, the policy document on CPD which the Department for Education and Employment (DfEE) published on 1 March, a few weeks after we held our oral evidence sessions. In giving evidence, Professor Julia Higgins from the Council for Science and Technology (CST) said that the Department for Education and Employment had "done a great deal" to improve the provision of CPD, but also that more could be done (Q. 19). We therefore considered ways in which a system of effective CPD should be implemented to meet the needs of both pupils and teachers.

Evidence

4. Two oral evidence sessions were held. The first, on 16 January, was with the Education Sub-Group of the CST led by Professor Higgins. In this meeting, we followed up issues relating to science in schools raised in a private meeting with the CST on 11 November 1999. The second oral evidence session was held on 23 January with Estelle Morris MP, Minister for School Standards at the DfEE.[2]

5. The principal matter for discussion in both meetings was continuing professional development, and particularly the CST report, *Science Teachers: A report on supporting and developing the profession of science teaching in primary and secondary schools*.[3] This report emphasised the need for Government and school management to recognise the importance of continuing, subject-specific, classroom-based CPD for those who teach science. In addition, we followed up two matters which arose from our earlier report *Science and Society*:[4] the idea of "scientific literacy" for all in the teaching of science in primary schools, and concerns that health and safety regulations and the

---

[1] See *Science and Society*, this Committee's 3rd Report 1999-2000, HL Paper 38, para. 6.15.

[2] Estelle Morris has responsibility only for schools in England. Aside from a few points of fact, however, the issues we raised in discussion are relevant across the United Kingdom.

[3] Report by the Council for Science and Technology (affiliated to the Office of Science and Technology at the Department of Trade and Industry), February 2000.

[4] See footnote 1.

possibility of legal action were limiting the amount of scientific practical work done in schools.[5] The transcripts of these exchanges are appended to this Report.

6. We also solicited written memoranda from a number of learned societies and teaching unions. These too are appended to this Report. We extend our thanks to those who took the time to contribute evidence to this Inquiry.

CONTINUING PROFESSIONAL DEVELOPMENT

Incentives

7. The provision of CPD is currently "highly variable school to school" (Q. 16). Pressures on management and finance are such that CPD is often not regarded as a priority, and there is a wide variation between schools in the amount of funding available for individual CPD (*Science Teachers*, para. 49). The CST wrote that the prevailing attitude of management towards professional development needs to be changed, so that governors, head teachers, line managers and staff come to accept CPD as an essential, beneficial and regular part of a teacher's career development (pp. 52-53).

8. All teachers in state schools currently have five In Service Education and Training (INSET) days per year. This time, however, is usually taken up with whole-school issues, national initiatives and matters of administration. Only rarely do teachers have the opportunity to refresh their subject-specific knowledge and improve their teaching skills.[6]

9. Other opportunities for CPD, such as the two-year part-time professional development programme run by the Association for Science Education (ASE), have had a disappointingly low take-up rate. Dr David Moore, the Director of the ASE, blamed this on a culture within the teaching profession which does not regard CPD as a priority (Q. 12). Negative experiences of INSET days spent form-filling have led many teachers to become disaffected with the idea of CPD.

10. We consider that this is the heart of the problem. In reality, good CPD should considerably increase teachers' professional satisfaction; yet teachers are not enthusiastic about CPD because they do not see what benefits they gain from it. Teachers at all levels therefore need to be persuaded that the time they spend on their own development will be formally recognised. As Professor Higgins put it (p. 53):

> "The new CPD strategy…will need to be much more than a statement of principles and aspirations. It must address clearly the crucial question of how and why it will secure buy-in from the teachers and the main levers by which this is to be secured in practice."

In their recent document, *Learning and Teaching: A strategy for professional development* (March 2001), the Government seek to exert "some degree of pressure" on teachers and to impose "a duty to take responsibility for their own professional development". Although the precise terms of this new duty have not been formulated, the imposition of new duties without corresponding benefits will simply reinforce the idea that CPD is another administrative encumbrance.

11. Currently, for teachers who actually teach rather than manage, performance-related pay applies to those who pass the 'threshold assessment' (taken after approximately 7–9 years' teaching experience) and to those who become Advanced Skills Teachers (ASTs).[7] Moreover, the Government intend that only 3% of teachers will eventually become ASTs: this system thus rewards CPD for a few exceptional teachers, but provides no incentives for the majority of teachers who are unlikely to achieve AST status. The Minister said that the Government had begun to create a long-term career structure for teachers (Q. 63), but we consider that currently the majority of teachers are rewarded only very infrequently for undertaking CPD; this must change. In other professions, such as medicine and engineering, the completion of professional development courses and/or regular attendance at CPD sessions attracts credits which are a precondition for promotion and increases in pay. We consider that such incentives should also be applied to teaching, to encourage teachers to take responsibility for their own professional development.

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[5] See *Science and Society*, Chapter 6: Science Education in Schools.

[6] See the CST report, para. 37.

[7] Advanced Skills Teachers are given an average of a day per week to share their teaching skills with other teachers within their own school and in other schools. Teachers apply to become ASTs and move on to an improved pay-scale if their applications are approved. Although the Government intend to expand the number of ASTs (*Learning and teaching*, paras 28-29) only 750 have so far been appointed.

12. **We recommend that CPD for teachers should be linked to a clear development structure at all levels of the profession with tangible benefits for teachers who successfully complete CPD courses.**

The Special Case for Science

13. We consider that CPD is particularly important for those who teach science. Science and the applications of science are constantly changing, and throwing up new and complex technical challenges and ethical dilemmas. As Professor Higgins observed (Q. 11):

> "If you were a biology graduate from 10 years ago, you would not recognise the current biology."

14. Science teachers, more than teachers of other subjects, need subject-specific training to keep their knowledge up-to-date. This argument was accepted by the Minister, who said:

> "I can quite see that scientists might make the case that their content knowledge changes and needs updating more than content knowledge elsewhere. I do not think I can argue against that" (Q. 71).

15. Many of those who teach science also find themselves teaching outside their specialist subject-area. A survey published at Annex A of the CST report shows that, at Key Stage 3 (ages 11-14), 37% of those teaching biology, 19% of those teaching chemistry and 37% of those teaching physics did not even have an A-level qualification in the subject. Primary school teachers receive some education in science in the course of their training; secondary science teachers receive none, and have to get by on what they bring from their own education. A thorough command of the subject, together with the confidence to move beyond the confines of the syllabus, is necessary if teachers are to teach well. This is particularly important in carrying out practical work. We consider that the decline in practical work in schools (discussed later in this report) is due at least in part to teachers lacking the knowledge and the confidence to conduct experiments safely. As a result, teachers are conducting practicals less and less often.

16. In *Science and Society* we also noted that the proportion of those beginning the Postgraduate Certificate in Education (PGCE) with third class degrees or lower is markedly higher in science than in arts subjects (see Table). Of course, someone with a third class degree may make a first-class teacher; nonetheless, he or she is likely to be more in need of subject-specific CPD than someone with a first.

Degree classes of PGCE entrants at "old" universities, 1993[8]

Subject	*% Third or below*
Physics	37.7
Maths	36.5
Chemistry	33.8
Biology	15.2
Geography	7.4
English	6.9
History	5.3

17. We therefore consider that the need for better provision of CPD is particularly pressing in science. **We recommend that those who teach science, and particularly those who teach beyond the scope of their degree, should be given priority in the development of CPD policy.**

Time and Money

18. The CST report emphasises that CPD should not only be classroom-based and subject-related, but should form a natural part of a teacher's working timetable. Ms Juliet Strang, a member of the CST working group, estimated that their proposals would require two hours of non-contact (non-teaching) time per week to be built into the timetable for each science teacher (Q. 5).

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[8] This table is reprinted from *Science and Society* p. 51. This research was carried out by Professor Alan Smithers, now Sydney Jones Professor of Education at the University of Liverpool.

19. The Minister, however, was very much against attempts to earmark time for CPD, not least because such allocations could easily be put to other uses, a difficulty already apparent with INSET (Q. 72). She also said that monitoring how such allocated time was used would be impractical.

20. We disagree with the Minister. We note that, in Scotland, the Executive, teaching unions and Local Education Authorities have recently agreed to a restructuring of teachers' terms of employment which incorporates less contact teaching time in the school week. As part of the package, which includes better pay, teachers have agreed to spend five days per year on CPD on top of their current time commitment. We consider that using part of the school holidays for CPD to take pressure off teachers in term time is worth further consideration in England.[9] **We recommend that, for CPD to be effective, regular time must be formally allocated to subject-specific development.**

21. Instead of allocating time, the Minister favoured "Professional Bursaries" which are currently being piloted in nine Local Education Authorities.[10] This idea is endorsed by the Institute of Physics (p. 57), and we also find the idea of "Professional Bursaries" attractive. But we are concerned that the amount of money made available is too little. Under the scheme, teachers are offered £500 per annum to spend on their own professional development in any way they choose.[11] But the amount of time that £500 could "buy" falls far short of what is recommended by the CST. For example, if the money were spent on supply cover,[12] and even if a suitably qualified supply teacher could be found, £500 would pay that teacher for only about 3 days.

22. We are also concerned that the Government plan to extend the scheme before its effectiveness has been properly assessed.[13]

23. The amount of time and money spent on CPD also seems very little given the difficulties in teacher recruitment, and the costs of low rates of teacher retention. Approximately 30-40% of newly qualified science teachers in grant-maintained secondary schools leave the profession within five years of qualifying (CST p. 53, and Q. 78). Moreover, each science teacher costs approximately £22,000 to train in the first year alone (Q. 81). The position was summarised by Dr Rob Margetts of the CST:

> "So much of the time we analyse in fine detail the cost side of the equation. On the benefits side, if one could reduce the turnover of science teachers at all then that is a very small price to pay on the cost side. The industrial analogy is, if you had a turnover approaching this level in your staff, you would be putting in almost anything possible to the staff you already have to retain them." (Q. 20)

We agree strongly with this view. Improved CPD alone will not encourage all teachers to remain in the profession, but it will (if linked with real incentives) encourage some teachers to stay, and will help to protect the considerable investment already made in the initial training of those who do.

24. We welcome the fact that the Government is putting additional resources into CPD totalling £92 million over the next 3 years.[14] In terms of the potential for reducing the enormous costs associated with replacing teachers who leave the profession, however, this seems to be a very minimal investment in CPD. **We recommend that the high cost of teacher turnover should be taken into greater account when allocating money for the provision of CPD.**

25. While such data as exist on departures from the teaching profession[15] suggest that premature wastage of science teachers is disproportionately high, we understand that such data are limited, and that no data exist on the crucial question why. In view of the waste of resources whenever a teacher quits, **we recommend that the DfEE should collect and analyse such data as a matter of some urgency.**

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[9] The Association for Science Education conference, for example, which is aimed primarily at teachers, takes place annually in early January before the start of the school term. It should be noted that many teachers attend this conference at their own initiative and expense.

[10] £10 million was committed to a two year pilot launched in September 2000.

[11] Eligible teachers in Education Action Zones and Excellence in Cities areas are entitled to an enhanced bursary of £700.

[12] As suggested by the Minister (Q. 72).

[13] Although the pilots are still on-going, the Government has announced £30 million to extend the scheme over the next three years (*Learning and Teaching*, p. 8).

[14] *Learning and teaching*, p. 2.

[15] Notably from the Local Government Management Board, the Teacher Training Agency, and the DfEE in evidence to the School Teachers' Review Body.

Validation and Audit

26. Both the CST and the Minister said that the quality and quantity of materials available to support CPD is not lacking, but that such materials are not well distributed. While some material is excellent, other material, especially from particular industrial interests or pressure groups, may be slanted and needs careful vetting. So much material arrives on the desks of head teachers and heads of departments, however, that they do not have the time to sift it thoroughly.[16] It is extraordinary that in a situation where science teachers are scarce, overburdened and find it difficult to keep themselves up-to-date, every school has to do its own validation of the materials which arrive.

27. The Minister was keen to stress that the Government should not be too prescriptive in the management of CPD and associated materials. The Government did not want to be seen to be censoring materials for schools (Q. 84), nor did they want to institute any new layers of bureaucracy. The Minister preferred the role of Government to be that of a facilitator.

28. Although a balance between the role of Government and the individual autonomy of schools is hard to strike, we consider that the Government could do more to assist schools to manage the quantity of CPD information which they receive. Initiatives such as the "Good Value CPD" code and the CPD website,[17] while they provide "good practice" guidelines, still leave the individual schools to do the work of validating materials for CPD. We therefore urge the Government to provide the resources to enable bodies such as the Association for Science Education, the General Teaching Council (GTC) and SETNET[18] to set up a national validating institution. Such a centralised body could not only distribute materials more effectively, but would free up time for teachers at a fraction of the cost of giving all heads of department time to do their own validation. It would also assess courses and materials produced by industry, pressure groups, museums and the learned societies, and implement a kitemarking scheme for validated materials. We do not consider that such activity would amount to "censorship".

29. The problem of effective implementation of professional development is further compounded by the lack of information regarding current provision of CPD, and the numbers, qualifications and skills of teachers.[19] We consider that such information is essential in order to establish how the problem of implementation can best be tackled. We are pleased therefore that the Government plans to develop "a major research and evaluation programme, in collaboration with the GTC and others in the profession".[20]

30. A national body could therefore both validate quality-assured CPD products and materials, and also co-ordinate such a major research and evaluation programme. **We recommend that the Government should fund an independent national body to validate materials and products for CPD, and to monitor their implementation and effectiveness.**

National Grid for Learning and Information and Communication Technology

31. The memorandum from the DfEE places great emphasis on the development of the National Grid for Learning (NGfL) and the importance of information and communication technology (ICT). The Minister was similarly keen to talk about ICT and the success of the NGfL (Qs 82 and 83). The National Union of Teachers, however, raised the point that "teachers' ability to access such technology is variable" (p. 60). For example, the DfEE's "Computers for Teachers" scheme has been made available this year only to teachers of Key Stage 3 mathematics in England. The Institute of Physics is further concerned that "face-to-face interaction" is much more effective than ICT-delivered training in increasing confidence (p. 56).

32. While ICT has great potential in this area, we consider that difficulties of access for many teachers persist. **We recommend that the implementation of CPD through ICT should not be promoted to the exclusion of improving more traditional resources.**

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[16] As an extreme example, Dr Ray Peacock told us: "I have talked to a head teacher who said that so much arrives on his desk that if it has not got his name on it, he throws it in the bin; if it has got his name on it and it looks flashy, it goes in the bin; he then reads what does not look flashy and has got his name on" (Q. 26).

[17] *Learning and teaching*, paras 29 and 33.

[18] SETNET, the Science Engineering Technology Mathematics Network, has 58 member organisations representing Government, industry, the engineering professional institutions, education and education charities. It is one of the outcomes of a Government initiative *Action for Engineering*. SETNET's "SETPOINTs" have as one of their tasks the obligation to operate at local level as independent resource advisers. By their contact with a range of schools, involvement with a variety of resources, and their knowledge of teacher and company reaction, SETPOINT managers are able to provide informed advice to teachers regarding the use of science, technology, engineering and mathematics resources.

[19] See memorandum by the Institute of Physics p. 57.

[20] *Learning and teaching*, para. 37.

Scientists and engineers in schools

33. The Minister mentioned that CPD material can be reinforced with opportunities for workplace visits or visits to schools by practising scientists and engineers. She mentioned in particular the Research Councils' Researcher in Residence scheme, and the Engineering Council's Neighbourhood Engineers (Q. 88); to this list we would add Women into Science and Engineering (WISE). The Minister observed that meeting such people can be an inspiring experience for children, and we very much agree; school visits by former pupils now working as scientists and engineers can be particularly valuable in giving children role models with whom they can identify.

SCIENCE IN PRIMARY SCHOOLS

34. Science is a vital part of universal education and is not just of relevance to future scientists. While we acknowledge that the drive for literacy and numeracy has had a beneficial effect on results in Key Stage 2 science (ages 7–11) (Q. 66), we share the Royal Society of Chemistry's concern that too much emphasis is being placed on acquiring factual knowledge at the expense of learning about scientific method.[21] We consider that this is antipathetic to the idea of "scientific literacy" for all, a recommendation made both by our report *Science and Society* (para. 6.12) and by the Nuffield Foundation in their report *Beyond 2000*.[22]

35. We are particularly concerned that teachers in primary schools are not generally well-informed about science. In *Science and Society* we reported a predominance of negative attitudes towards science amongst primary school teachers, particularly towards chemistry and industry.[23] The lack of provision for training primary school teachers in science was also acknowledged by the Minister, who admitted that this is "an area that is not yet fully met" (Q. 90).

36. **We recommend that science-specific CPD should also be available to primary school teachers, to encourage them to understand and promote science in the earliest years of a child's education. The value of inspirational teaching at this stage cannot be overemphasised.**

PRACTICALS IN SCHOOLS

37. Practical work catches the imagination of the young and can excite them about science from an early age. The decline in the amount of practical work done in schools, which we first raised in *Science and Society* (para. 6.14), continues therefore to concern us.

38. In their response to *Science and Society*, the Government denied that regulation was preventing the conducting of practicals in schools. This view is supported by the Royal Society of Chemistry, who state in their memorandum (p. 61): "In the past 30 years only two commonly used experiments have been removed from the curriculum (both involving the use of benzene)". They also state: "Of itself, regulation does not prevent students experiencing good hands-on science".

39. Dr David Moore, however, of the Association for Science Education, said that "the Health and Safety Executive should contribute to making life easier for teachers". The Royal Society of Chemistry's memorandum further states that practical science is hindered by "an erroneous interpretation of the regulations and over-stringent enforcement and practice at a local level." In addition, Dr Kay Stephenson said that "the confidence and competence of the teacher in the classroom" need to be improved to counteract this trend, "and that comes down to training" (Q. 47).

40. We support this view, as we consider that health and safety regulations, if they do not actually ban experiments, nonetheless affect adversely the way in which they can be carried out. The emphasis on risk assessment and safety regulations in the Government response to *Science and Society* (paras 73–76) further indicates the extent to which safe practical work is being inhibited. Moreover, we consider that the regulations create an atmosphere of excessive caution which, coupled with a growing hostility to experiments with animals, fosters squeamishness and discourages teachers from conducting interesting practical demonstrations.

41. Practical work is also expensive, by comparison with other forms of classroom teaching, and proper practical work requires dedicated teaching laboratories and support staff. It would not be surprising if, at a time of financial stringency, many schools felt that they had other, higher priorities.

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[21] See the memorandum by the Royal Society of Chemistry (p. 61).

[22] *Beyond 2000: Science education for the future* (1998).

[23] See the Royal Society of Chemistry's *Huddersfield Experiment*, discussed in *Science and Society* (Q. 432 and paras 6.6-6.7).

42. **We recommend that CPD should be specifically targeted at the problem of declining practical work, to give teachers the knowledge and the confidence to enable children to carry out good hands-on science without incurring significant risk.**

SUMMARY OF RECOMMENDATIONS

1. Continuing Professional Development (CPD) for teachers should be linked to a clear development structure at all levels of the profession with tangible benefits for teachers who successfully complete CPD courses (para. 12).
2. Those who teach science, and particularly those who teach beyond the scope of their degree, should be given priority in the development of CPD policy (para. 17).
3. For CPD to be effective, regular time must be formally allocated to subject-specific development (para. 20).
4. The high cost of teacher turnover should be taken into greater account when allocating money for the provision of CPD (para. 24).
5. The Department for Education and Employment should, as a matter of some urgency, collect and analyse data on why so many teachers leave the profession (para. 25).
6. The Government should fund an independent national body to validate materials and products for CPD, and to monitor their implementation and effectiveness (para. 30).
7. The implementation of CPD through Information and Communication Technology should not be promoted to the exclusion of improving more traditional resources (para. 32).
8. Science-specific CPD should be available to primary school teachers, to encourage them to understand and promote science in the earliest years of a child's education. The value of inspirational teaching at this stage cannot be overemphasised (para. 36).
9. CPD should be specifically targeted at the problem of declining practical work, to give teachers the knowledge and the confidence to enable children to carry out good hands-on science without incurring significant risk (para. 42).

APPENDIX 1

The members of the Select Committee are:

Lord Flowers (*co-opted*)
Lord Haskel
Lord Howie of Troon
Lord Jenkin of Roding
Lord Lewis of Newnham
Lord McColl of Dulwich
Lord Methuen
Lord Oxburgh
Lord Patel
Lord Perry of Walton
Baroness Platt of Writtle
Lord Quirk
Lord Rea
Lord Wade of Chorlton
Baroness Walmsley
Lord Walton of Detchant
Baroness Warwick of Undercliffe
Baroness Wilcox
Lord Winston (*Chairman*)

Declarations of interest

Lord Flowers—Former Chairman, Nuffield Foundation

Lord Jenkin of Roding—Chairman of the Foundation for Science and Technology

Baroness Platt of Writtle—Patron WISE (Women into Science and Engineering); former President of the Association for Science Education; former Chairman, Education Committee, Essex County Council; former Vice-Chairman, London Regional Advisory Council for Technological Education

Lord Quirk—Trustee of the Wolfson Foundation (on the Educational Panel)

Lord Walton of Detchant—Former Chairman of the Hamlyn Foundation National Commission on Education

APPENDIX 2

Witnesses

The following witnesses gave evidence. Those marked * gave oral evidence.

Association for Science Education

* Council for Science and Technology
    Professor Julia Higgins
    Dr Rob Margetts
    Dame Bridget Ogilvie
    Dr David Moore (Association for Science Education)
    Dr Ray Peacock (Science Engineering Technology Mathematics Network)
    Ms Juliet Strang (Head of Villiers High School, Ealing)
    Dr Kay Stephenson (Head of Science and Chemistry, Felsted School, Essex)
    Mr Justin Dillion (School of Education, King's College London)
    Steve Elton (Office of Science and Technology)
    Professor David King (Chief Scientific Adviser)

* Estelle Morris MP, Minister for School Standards, Mr Richard Harrison and Mr Ian Berry, Department for Education and Employment

Institute of Physics

National Association of School Masters Union of Women Teachers

National Union of Teachers

Royal Society of Chemistry

MINUTES OF EVIDENCE

TAKEN BEFORE THE SCIENCE AND TECHNOLOGY COMMITTEE (SUB-COMMITTEE I)

TUESDAY 16 JANUARY 2001

Present:

Flowers, L.
Jenkin of Roding, L.
Methuen, L.
Patel, L.
Perry of Walton, L.
Platt of Writtle, B.
Quirk, L.
Tombs, L.
Wade of Chorlton, L.
Walmsley, B.
Walton of Detchant, L.
Warwick of Undercliffe, B.
Wilcox, B.
Winston, L. (Chairman)

Examination of Witnesses

Professor Julia Higgins, Council for Science and Technology, Dr Rob Margetts, Council for Science and Technology, Dame Bridget Ogilvie, Dr David Moore, Association for Science Education, Dr Ray Peacock, Science Engineering Technology Mathematics Network, Ms Juliet Strang, Head of Villiers High School, Ealing, Dr Kay Stephenson, Head of Science and Chemistry, Felsted School, Essex, Mr Justin Dillon, School of Education, King's College London, Mr Steve Elton, Office of Science and Technology, Secretary to the Council for Science and Technology, and Professor David King, Chief Scientific Adviser, called in and examined.

Chairman

1. Professor Higgins, thank you very much for coming to this Committee. It is very good to see you and it is a pleasure to have read your material. It is also the first time we have met Professor King as a Committee and it is good to see him here as well. I wonder if you would like to introduce the members of your team?

(*Professor Higgins*) We understand we are a very large group for you to see.

2. It is a bit daunting for us. I think you outnumber us actually!

(*Professor Higgins*) Thank you very much. It is a pleasure to introduce the members of the working group and the members of the Council for Science and Technology (the CST) who are here. David King you have already welcomed, and we are very pleased he has been able to join us today since he has only recently taken up his post as Scientific Adviser. There are a large number of the team who met with you before. I am told it was 11th November 1999, it does not seem as long ago as that. With me I have Rob Margetts, who is the Chairman of Legal and General and Chairman (Europe) of Huntsman Corporation, and a current member of the Council of Science and Technology. Bridget Ogilvie, who was a long-standing CST member but she decided to stand down last March, and she is still a Director of NESTA among other bodies. Many of you will have met her with different hats on. Dr David Moore is Chief Executive of the Association for Science Education. Dr Ray Peacock is Chief Executive of the Science, Engineering, Technology, Mathematics Network. Mr Justin Dillon, from the School of Education, King's College London, very much involved with the production of our report and carried out the survey. Ms Juliet Strang is Head of the Villiers High School in Ealing. Dr Kay Stephenson, Head of Science and Chemistry at Felsted School, Essex. We would have had a third teacher here but she has, within a few days, produced her first baby and she had rather more important things on her mind than coming to talk to your Lordships, although she is very disappointed not to be here. I would like, for the record, to express my appreciation and gratitude to you and the Committee for your continuing interest in our work, and to each of the members of my team for their efforts. Their work and support has been invaluable, both in preparing the report and in our subsequent follow-up activities. I should just like to explain that two of the founding members of the Council and members of the original group were Sir Aaron Klug, who was then President of the Royal Society, and Professor Sir Stuart Sutherland. They stood down from the Council in the past year and they have both asked me to convey their apologies to this meeting. In view of the composition of the team today, in which Rob Margetts and I are the only current members of the Council for Science and Technology, I should perhaps explain that we are not intending to speak on behalf of the Council as such. The members will assist your inquiry by using our own personal views, our own personal expertise from our own individual standpoints, and of course refer to our joint work together on the report. I hope that is acceptable to the Committee and to you, your Lordship. I hope you have found the memorandum which I prepared with Steve Elton helpful in terms of setting the scene for today's discussion. As fellow scientists, you and members of your Committee are very aware of the distinction between cause and association. We would not make the case for the CST's report but we do note the strong correlation between its thrust and the directions which the Government's policies have been taking lately, and we are very pleased to note that. Thank you.

3. Thank you very much indeed. We have prepared a formidable list of questions which troubles me rather a lot, because I think my whole reputation as a chairman is going to depend on getting us through

Chairman *Contd.*]

the majority of this agenda, and I am not sure I am going to manage it. So I am going to try and keep up a reasonable pace, if that is all right, and no doubt you will decide which member of your group will be best placed to answer the questions. I will kick off with the first question on the list which is the motivating factors behind the setting up of the inquiry into science teachers. Why did you become interested in this particular area? Crucially, what do you consider to be the most pressing recommendations of the report?

(*Professor Higgins*) The Council for Science and Technology, as you will know, exists to provide advice. At its first meeting after it was re-formed it looked at a number of issues which it considered important in science and technology in this country, and it became very quickly clear that there was a consensus that attention to science education was absolutely crucial if any of the other factors were to take place; it was absolutely fundamental. The Council therefore set up a working group under my chairmanship with a number of the members that I have mentioned already from the Council working on it, and we invited David Moore and Ray Peacock to join us. We then had a look at a scoping study of where we might focus usefully the Council for Science and Technology's attention; we were not arrogant enough to believe we could attend to the whole of science education from infant through to university. It became quickly clear that the centre of attention ought to be the teachers themselves and ought to be what is happening in the age range between about 9 and 14. It is a key age range where we lose children from science. That is the background to the report. It was made possible by what we believe is a first, a survey of science teachers asking them what they thought they needed, and many of them told us it was the first time anybody had asked them personally what they needed. This was carried out for us by King's College and Justin Dillon here was the driver for that and the driver of the report. We believe all of the recommendations that we have come up with are important in the sense that the absolute key is this focus on the continuing professional development of science teachers and the entitlement for every science teacher in secondary schools to have continuing professional development. Everything is focused around that and the facilitation of that.

(*Mr Dillon*) All the recommendations are interrelated and are not necessarily separable, but the great perceived need of science teachers is for long-term personal professional development to enhance their subject knowledge and the ability to teach their own subject and subjects for which they were not trained, which they now find themselves teaching.

Baroness Platt of Writtle

4. I am so pleased to hear you say that because I am sure you are right. I have just recently read the National Institute for Careers Education and Counselling (NICEC) Report, *Choosing Science at 16*, the Hawley Group Report, *Making the Best of Valuable Talent* and the Goodison Report, *Learning in the Work Place*, and they all say the same thing. Who is currently responsible for teachers' CPD? Is in-service training more properly a matter for individual schools than the Government? Could your recommended changes be made within the current system of INSET? If not, why not?

(*Dr Moore*) In the first instance, we have had five in-service days available in schools for a number of years. Our concern has been that although the issues which have been dealt with have been important, they have seldom dealt with them at an individual level. Particularly we believe in science, where science knowledge is important and progresses, that should be addressed but it is clearly not being done. We provide quite a lot of in-service training, but it is entirely down to the individual to opt into it. There is a modest amount of money available in schools but it certainly does not cover all the needs of all teachers. More importantly, it is a recognition of the need which is I think still sadly lacking, particularly in terms of subject knowledge and ability to deliver the subject.

5. You mention money. Reading the DfEE memorandum in response to your original report, in paragraph 9 they say a lot of things which are good but they do not mention money at all.

(*Professor Higgins*) How long is a piece of string? How much does this cost? We do not believe the Council for Science and Technology is in a position to put a costing on this, but we made a rough estimate of the length of time we thought might be necessary. Juliet Strang is a head teacher and she gave us an idea of what she thought might be the necessary amount.

(*Ms Strang*) I think something like two hours a week would be a reasonable estimate of how much time we should offer to teachers for their own professional development. Two hours a week for all science teachers in my school would amount to about two-thirds of a teacher, which is probably about £20,000 a school, which we calculated would be about £100 million across the country in terms of offering this level of resource to allow this to take place.

(*Professor Higgins*) One of the things we do feel is important though is that one should look at the benefits as well as the costs. There is a 30 to 40 per cent turnover in teachers in the first five years in their careers and there is a loss to the system of those trained people, so one would have to cost it properly. We are talking about a benefit of course, and we are talking about an entitlement for children to a high quality science education. The roll-on effect to the country is very difficult to quantify but we believe it to be enormously important.

Lord Walton of Detchant

6. Do you see any developing facilitatory role in this regard in relation to continuing professional development for the College of Teachers? The reason I ask this is because we had a number of meetings with them in this House, originally chaired by the Viscount Caldecote, who sadly died, and then later by Lord Butterfield, who also died. As far as I know it is still developing and I understand that one of the purposes of that College is to try to facilitate and

Lord Walton of Detchant *contd.*]
develop programmes of post-graduate training for teachers.

(*Professor Higgins*) I think we do.

(*Mr Dillon*) The General Teaching Council is still in its infancy and there is discussion to be had about the role that it would have in professional development; who would have responsibility for professional development? The feeling from our survey was that the teachers perceive a need for some sort of national framework, a personal entitlement and mechanism for that entitlement to be delivered. There is also the issue of the cost effectiveness. We are not necessarily looking at additional resources but better use of existing resources, so there would be a chance to re-focus some of the money spent on general in-service initiatives across the curriculum on specific resources for developing science teachers.

Lord Tombs

7. In paragraph 49 of your report you drew attention to the extremely wide variation in per capita funding for INSET and CPD combined, and it really is extraordinary, it is a factor of ten. Why is this? Have you managed to make any impression on the DfEE to unify it or to rationalise it?

(*Professor Higgins*) A lot of our work is to make an impression on DfEE and there has been a lot of co-operation between us. I personally do not have an answer to that and I am not sure whether we do have a feeling as to why this huge variation exists.

(*Mr Dillon*) My impression is that some of the extremes are due to there being particular instances of very small schools or schools which have benefited from a special input of money, but nevertheless there is still quite a big standard deviation which indicates that schools have some autonomy and some are prioritising professional development far more than others. The implication of that is that some teachers are getting more of their fair share of the cake than others when it comes to professional development.

8. I wonder whether there is any correlation between this distribution in the table and the 53 per cent of the people who did not reply to the questionnaire?

(*Professor Higgins*) I do not think that is one of the correlations we made, is it?

(*Mr Dillon*) That would be very difficult to do.

(*Professor Higgins*) That would be hard, yes.

Lord Flowers

9. I wanted to ask a supplementary too, my Lord Chairman. You have been deliberately, so you say, vague about the National Centre for Excellence. I am not very happy about vagueness, I wonder whether you had a slightly more clear view to put to us than you had at the time you wrote the report. Is it a virtual centre? Is it a real centre? Do people go there? Does it issue documents?

(*Professor Higgins*) Our own thinking at the moment, and we are not the Executive, we advise, is that it is almost certainly virtual, but it is a source of material and advice and expertise. However, we ourselves are uncomfortable about just dropping that because we think it is very important, and we know that the DfEE has agreed that there should be an investigatory study, and my own group is going to meet together to consider its ideas for feeding into that investigatory study. Rob was particularly concerned about this issue.

(*Dr Margetts*) We do recognise our work is incomplete and that in regard to this National Centre we do believe there is a requirement to set good standards, that teachers must be involved in that process, so it is not only teacher-designed but teacher-friendly, almost certainly virtual, almost certainly bringing together a whole lot of bodies who are providing competent work but with varied mechanisms to deliver it.

10. Would you be working through the internet?

(*Dr Margetts*) Yes. Our plan is over the coming weeks and months to develop our thoughts a little further so we can provide good advice to the DfEE.

Lord Quirk

11. Obviously there are three parts to this third question. The answer to the first is clearly, from the point of view of your Council and indeed of this Committee, yes, science teachers are a special case. But, as Professor Higgins points out on page 4 of the memorandum, there is not a framework of professionally recognised and accredited qualifications for teachers in general. Clearly, although science teachers are presenting a particular crisis at the moment, they are not the only ones which are in short supply and they are not the only ones who, I would imagine, you would feel are in need of professional development. I wonder if you had thought of the extent to which the professional development of science teachers could be put into the context of the profession as a whole, the relation of professional development to the only structured additional qualification we have currently got, the Advanced Skills Teacher, and the various benchmarks that would give individual teachers the feeling that their portfolio was being visibly advanced. There is a certain degree to my mind of amorphousness about this concept of professional development at the moment and I would like to see benchmarks and some indication of structuring. Of course the third part of this question, what would be the effect of putting more resources into CPD for science teachers alone, does bring us back to the issue of resources which were earlier mentioned and the rest of the profession might well be a little alarmed.

(*Professor Higgins*) A whole raft of questions there, my Lord, and I will call on several of my colleagues to answer them. From the very beginning we asked ourselves the question, is science different, and it is different, we believe, for a number of reasons. It is laboratory based, it is experimental based, it is changing at an alarmingly rapid rate. If you were a biology graduate from ten years ago, you would not recognise the current biology, and the same with physics, the same with chemistry. There is a very great shortage of teachers and a big turnover. So if you add all those together, we believe it is different. I would like to ask Kay Stephenson to comment—she is a chemistry teacher and head of a

Lord Quirk *contd.*]
science department—before we talk about the effect of the actual framework.

(*Dr Stephenson*) The situation that I find myself in as head of science is that I came out of industry from research and I am teaching a subject now where I have to try and keep on top of innovative applications of the subject. The basic chemistry itself tends not to change but the application of it does, and I need to try and keep on top of that, and I also need to make sure the people who work for me in the department are able to teach those applications and have a good understanding of the subject. At the moment I have a biology teacher whose only background is biology, she did not do any chemistry beyond school level prior to teaching, and she is having to teach chemistry in the school. I need to make sure she is trained to deliver chemistry, not just the theory but the practical aspects. That is taking us time and effort and we need to lay our hands on some better resources, and I need to be able to do that to shuffle people around and it is difficult at the moment.

(*Professor Higgins*) Justin, would you like to comment on this framework question and how much this would slot into the benchmarking which is being put in place for CPD generally?

(*Mr Dillon*) The DfEE already have outlined, the Government has outlined, its strategy for continuing professional development, and we would see some of the recommendations of the CST report as integrating with the overall philosophy of this CPD framework. The idea of having a framework is one which many of the teachers in our report would have supported; something which provides a mechanism, an opportunity, for all teachers to have some idea throughout their professional lives they would have something to aim for, something to work towards, rather than the minority of teachers which the Advanced Skills Teachers might only apply to. Also one thing we should stress is that what we have here is something which may be experimental, which for science teachers may be an experimental scheme but the lessons from that may be applicable across the whole range of other subjects in primary as well as secondary education.

Lord Quirk: Mr Dillon mentioned in response to a point raised by Lord Walton earlier, I think, the role of the General Teaching Council which I think Mr Dillon indicated had not yet had a chance to take shape. Of course, Lord Walton was referring to another body, the attempt to bring back to life the College of Preceptors as the College of Teachers. But apart from that surely the GTC could have a key role in determining the parameters of professional development for science teachers and others?

Lord Walton of Detchant

12. Could I clarify that point? I was much involved in some of the discussions about the College of Teachers. It grew out of the College of Preceptors, as Lord Quirk has said, but its hope and intention as it continued to recruit more and more teachers was to have some kind of role rather like the medical model—I speak as a doctor—whereby the royal colleges provide higher qualifications and post-graduate examinations but the General Medical Council validates and examines the quality of such qualifications but does not provide them. The hope and the intention of the College of Teachers was to provide post-graduate qualifications to which teachers, not just in science but in all subjects, could aim, but the General Teaching Council would have the role of validation and examining the quality. That was why I raised that particular point.

(*Dr Moore*) We have recognised that within our Association we have a framework in place which is currently being funded by DfEE and the Teacher Training Agency which tries to identify teacher development over the first three or four years in the profession and awards a certificate which is validated by ourselves and the Open University, but we are only in the first year of this. I have to say the up-take in many ways has been much less than we would have liked. I think that is to do with the culture within the teaching profession and the acknowledgement by management and others of the need for professional development. So the great opportunity you are providing us with today is to raise the profile of all of that and the College may have a role to play and we believe the General Teaching Council does have a role to play. I am certainly working with other subject associations because the model we have is perfectly applicable to them. There is no doubt in our view that the young teachers we talk to want to have a target to go for, they want acknowledgement when they have got there, and then beyond that there are different stages. I belong to a culture where, when I started teaching in the mid-60s, I had the expectation my degree would fit me for the next 40 years, there was never a need to develop and there is still no recognised need. So one of the outcomes of this is the need for professional development. The second one is how to make it come about, because our teachers are keen to do that but the climate is not always supportive. Some schools are very good, but many I believe have not seen the importance of it yet. There are good ideas around but it is bringing coherence to it.

Baroness Platt of Writtle

13. Whilst being greatly in favour of CPD for science teachers as David Moore has just suggested, is it not also important that history teachers should know more about science and, for instance, should not modern languages teachers have scientific knowledge, so that you make it a broader subject? So often people think of science as vocational and narrow, whereas it is not, it is in fact education for life.

(*Professor Higgins*) I think it is desirable. It is not what we have addressed in our report because I am not sure we would know how to do it, but I personally would agree with you, it is highly desirable. One of the ways that will happen is that if we get better science teachers into schools, we will have children who are more switched on to science and we will produce an educated population and then our history teachers will naturally know more about science.

Lord Methuen

14. My concern is a purely practical one. My worry is that unless you have extremely firm management in schools, CPD is going to be seen as a luxury which they cannot afford because of the pressures on time and money, and people are just not going to be able to do it.

(*Professor Higgins*) This is something our headmistress could comment on.

(*Ms Strang*) That is something we have talked about quite a lot, the need for there to be very good management at school level to make sure CPD does actually happen. We think one of the key issues here is that heads of department should have enough professional development to be able to lead the professional development of the staff within their schools. It is not enough to organise systems for science teachers alone, there must be professional development for those who manage professional development in schools. So, for example, they have the skill to be able to work alongside teachers in the classroom, to be able to motivate those teachers to work with them in such a way they are enthused to develop their professional skills to a greater extent. That is an important key component of what we are saying here. Any systems we operate must address the management of CPD at a school level.

15. To what extent do you see local industry which may be relevant to the science base helping you in this task?

(*Professor Higgins*) Maybe Rob could come in on this because he has some experience of industry interaction with schools.

(*Dr Margetts*) Potentially a great deal but it is going to be quite uneven. A lot of companies do have interactions with schools, whether they provide lectures, materials, opportunities for visits or even placements. Indeed Ray Peacock's activities in SETNET are spreading that interaction nationally. Perhaps I could come back to the first part of your question, if I may. I certainly see this whole issue as one of local leadership—head teachers, heads of departments and indeed I think there is a role for governors also within this—but that has all got to be in a national framework which requires and expects head teachers to deliver CPD and then connects it one way or another to the levers, whether those levers are the appraisal system, the inspection system, the curriculum, or indeed the help side of the equation which is training for head teachers and heads of department as managers—and I am choosing an industrial analogy here—which I gather is likely to take place in the National College of School Leadership. To get traction on this whole issue one has to focus on the local delivery by head teachers and heads of department like Juliet and Kay within an expectation which is set nationally that they are required to do this.

(*Dr Peacock*) May I link some of these points up? It is vital, of course, to have a structure by which things happen, I think it is also vital to have some sort of levels you can see you have achieved. One of the things which became very clear when the survey was done is that the confidence in teaching drops off in science teaching at Key Stage 4. A number of the organisations I have been associated with recognise that the relevance of what you are learning to the world about you seems to be very effective hooks on to which to hang any subjects like mathematics or science and technology; if you can hang it on to a hook, it becomes very relevant to you. So you need the process, you need the levels, but the subject knowledge is the thing which I am extremely positive we have to do something about, not only to keep up-to-date with the changes which are going on but also the people who are teaching outside their subject. Subject knowledge is vital to be able to answer the kids' questions about why such-and-such happens. This also links with the point Rob was making, that many of the activities that companies do do actually allow some degree—it is patchy, it is varied—of relevance so that you can come back from seeing something and you are able to talk to the kids about why they are learning this subject. So subject knowledge I think is the thing which is desperate. You can have the process, you can have the levels, but what are you going to do to develop the teachers, and developing the subject knowledge in the science area is a very important part of that professional development.

Baroness Walmsley

16. I would like to explore a little further the reasons why teachers are not coming forward for additional voluntary CPD at the moment. It is clearly easy to ask the people who do come forward why they have done so, but it is much more difficult to find out the reasons why people do not come forward. Has any attempt been made to do that? If so, what are the results?

(*Mr Dillon*) It came through in the discussion groups which came out after the questionnaire. It is partly to do with time and money but also to do with access in that in many parts of the country teachers do not have access to high quality personal development in-service. So quality is an issue. It is also need, it is not seen by management as a priority compared with some of the other national initiatives on literacy or numeracy so, as someone was saying earlier, maybe it is driven nearer the bottom of the pile in terms of people's wants.

(*Dr Margetts*) It is very highly variable school to school. It is a cultural issue as to whether or not individual development is a key part of the working process.

Lord Flowers

17. Professor Higgins, I personally liked your report very much, but more important than my reaction is those of three very important groups—the scientific community, the education community, and you have mentioned the management side of that, and the Government. Would you like to tell us what their reactions are, as far as you know?

(*Professor Higgins*) As far as I personally have been aware, they have been extremely good. I have not met a person who has seen the report who has not appreciated it. I think Bridget has been talking to people outside in various fora.

Lord Flowers *contd.*]

(*Dame Bridget Ogilvie*) Lord Flowers, the report has been widely circulated, it is on the CST website and our very efficient secretary, Steve Elton, has made sure that the key bodies such as the Institute of Physics, the Royal Society for Chemistry, the Royal Society and others, have had copies and have had opportunities to comment on it. Wearing another hat, I chair the AstraZeneca Science Teaching Trust which happens to have done the same sort of thing; it has focused on trying to help continous professional development of teachers but in this case in primary schools, again by consulting the profession. All the bodies I have talked to, and all of us sitting here have talked to, have been incredibly positive about the report, but as for many members of your Lordship's House, and as for we ourselves, the key issue is how we implement this and ensure CPD is both implemented and embedded in the teaching profession, particularly in this case science. But, as you have already stated and I agree with you, it needs to be embedded in the whole profession to ensure high quality teaching for our children, which is the main issue.

18. Has the CST specifically appointed somebody not only to distribute but promote and follow-up this report?

(*Professor Higgins*) I think two things are happening. One is that the Council for Science and Technology itself believes the report and the subsequent action is so important that it has not yet managed to put it to bed, so there is a continuing commitment in the CST—and you will have noticed in our memorandum that some of the new members have expressed an interest in joining the working group—so CST has a certain intention of keeping an overview on what is going on. We cannot ourselves implement it. Quite clearly it is in the hands of the DfEE who are the payholders, as it were, they are the key people in implementing it. We have had throughout the preparation of the report very constructive discussion with the DfEE and I believe you are talking to Estelle Morris next week on this same issue. That is the route for carrying it on. We, equally, have been talking to a number of organisations—David Moore has obviously been talking to the Association for Science Education—and in a sense what we are doing is raising the profile. This meeting today is raising the profile and we are very grateful for it because raising the issue and constantly pushing is very important, but we believe that the actual process of taking it forward will have to be in the hands of the DfEE.

19. Do you think the DfEE is doing all it can so far?

(*Professor Higgins*) I am not noted for my tact at home! I think it has done a great deal, I think more can be done and I do not think we should stop pushing.

Lord Flowers: Understood.

Lord Walton of Detchant

20. I think Question 6 has been largely answered because you told us that the cost would be based upon two hours a week but would the CST have an ideal target at which to aim for CPD for teachers in terms of time? Admittedly you are not responsible for costing, but if you had an ideal target in terms of time then it would be up to Government and other bodies to determine what the cost of that would be. What is your attitude to that possibility?

(*Professor Higgins*) We talked about two hours a week, we have also talked about between five and ten days a year. Rob has some views on the view from industry.

(*Dr Margetts*) I think it will vary according to where the teacher is in their career. In those first few years, particularly if they are having to teach across subjects, then one could see that number being higher, and clearly as they gain experience and confidence then the number would tail off. Five to ten days a year on average actually equates very well with the professionals in industry and what the expectation is of the sort of training they will require. I just make a comment on the benefit side, because so much of the time we analyse in fine detail the cost side of the equation. On the benefits side, if one could reduce the turnover of science teachers at all then that is a very small price to pay on the cost side. The industrial analogy is, if you had a turnover approaching this level in your staff, you would be putting in almost anything possible to the staff you already have to retain them, build their skills and build their job satisfaction in delivering their product. It is amazing to me as an industrialist to see these low levels of CPD for teaching staff.

21. To what extent, if at all, do schools make available any expenses to enable teachers to attend major scientific conferences?

(*Professor Higgins*) I think again this is extremely variable. It is up to the school as far as I understand it. Some do, some do not.

(*Dame Bridget Ogilvie*) All Government departments and all of us are always concerned about cost, but I would like to endorse what Rob Margetts has said, the cost of turnover is absolutely enormous and I have never seen figures related to this. I would very much hope that we could find out from the DfEE how they cost turnover because it is a colossal drain on their resources.

Baroness Walmsley

22. Do you think this issue of entitlement to CPD should be linked to the issue of so many science teachers having to teach a subject outside their own degree subject? Should there be more entitlement for time provided by the school in those situations specifically rather than the teachers' own time, which they are less likely to be prepared to give?

(*Professor Higgins*) I think you would want to be quite careful about saying that. I believe there will be a sub-set where that is the case, but if one simply says—to paraphrase what you said—"In order to train biologists to teach physics we need some time", I think we will miss out a whole raft of other areas. It is also true that a biologist may not be competent in biology, that the physicist may need to know more about physics, that they will not feel confident in their subjects. So there are two things here. One is being confident across subjects, but the other is being confident in your own subject. Although I believe it is important, and I would like Justin and David to

Baroness Walmsley *contd.*]

comment on it, my own view is that we would not want to make that hook too strong.

(*Dr Moore*) I think that is fair comment but I think the range of ability within the science profession is probably as important as the range of skills they have. Starting the process is more important, I think, than identifying what those needs are and trying to second-guess now how much we should be able to provide.

Baroness Warwick of Undercliffe

23. You have answered about the cost, which is obviously going to loom large when it comes to pressure on the Department or the various departments. You have said two hours a week for each teacher or possibly five to ten days a year. I noted that Mr Dillon talked about not necessarily looking for new resources but a reallocation of existing INSET resources, and that may be something perhaps we could explore. I also noted from the DfEE memorandum to us little mention of resources other than to say in their paragraph 9(f), "continuing efforts should be made to look for better ways to use the time and resources available." That is a totally different mind-set from the one you are trying to create and I wonder whether there is one change that you perceive as being vital to begin to change that mindset? Is there one thing which you could see as being vitally important?

(*Mr Dillon*) I do not know. I think the shifting emphasis in professional development away from whole school initiatives and more towards subject-focused initiatives is certainly a short-term key move which I think will shift the focus more on to the individual and the subject, and making better use of existing resources from third parties in terms of, maybe, less books and videos and more professional development and more support. I think those are probably the two ones which jump out. The third one is moving away from one-day courses, more towards more classroom focused support, so you were not necessarily giving up time but getting better use out of your classroom time, because somebody was there watching you or you were able to reflect better on the way you were teaching, so you could raise the standard of your teaching through that process without giving up teaching time.

24. Does that fit in with the point you were making?

(*Ms Strang*) I would come back to the point which has been made already about the management of professional development and that school managers need to have professional development to work with teachers and to be skilled in doing that and become skilled in doing that. That actually requires quite a lot of professional development for those managers so they can work alongside teachers in the classroom. That does also require time because for a head of department to go in and work with another teacher means they cannot be teaching at the same time and then when the head of department has been in a lesson they need to find about an hour to sit down and talk about what has happened in the lesson, so that immediately is about two hours of the heads of department's time for one teacher. To be able to do that well, heads of department have to really be very skilled, because it is a highly skilled task and it is not just something we can ask people to do overnight. They have to be trained to do that. I would say that was key.

(*Professor Higgins*) In answer to your question, the key is making sure the middle managers and the heads, top management in the schools, understand and are trained in what has to happen, and a recognition from Government that there is a cost. The cost may not be the obvious one of simply putting more money in, it is a cost in time and resource. You cannot ask the teachers to do it in their spare time because quite a lot of what we are talking about is classroom-based and it has to be done during the school day and therefore that requires the resource to release that time during the school day. Money to provide the time is what we are talking about. There has to be a recognition that time is required to do that.

Lord Tombs

25. Amongst the blizzard of information which schools receive from Government and others, there are some quite good nuggets from learned societies, museums and so on. How do schools sort those out? How do they winnow the wheat from the chaff? Is there a role for the National Grid for Learning here? Can it be seen to be doing this? Is there a role for an approved authority, maybe the Association of Science Education, for example?

(*Professor Higgins*) Let me ask the teachers first and then go on to the people who might provide it.

(*Dr Stephenson*) Can I take a step back because it is linked to some of the things we have been talking about. As a classroom teacher and head of department, my concern—and every teacher's concern—is the quality of teaching and learning which goes on in the classroom. So you can produce all the Key Stage 3 documents you like, you can produce all the schemes of work you like, I can jump through hoops the same as any competent person can, but what we are interested in is how well they deliver the classroom material. That surely is what we are talking about, how well our teachers can teach, either their own subject or another subject. Looking at the resources that we get in, some of them are brilliant, they are superb resources, there are real nuggets in there—and I will answer the question about how you separate the wheat from the chaff in a minute—but they are useless unless the people delivering them know how to deliver them well. That is the main thrust of what we are talking about. Continual professional development is to teach teachers how to teach well, whatever they are teaching, but science is a special case because there is so much going on. To sift the wheat from the chaff means literally time. I have to spend time going through the rubbish that arrives on my desk until I find a really good piece. One point I would make is that companies produce wonderful things for us but they come as a package and as a teacher I cannot make use of the whole package. What we need are flexible resources you can use to dip into them. Yes, the National Grid for Learning could be a very useful

Lord Tombs *contd.*]

point of contact here. I have had a look at it, there are some useful things in there, but it needs to be a flexible resource which I can dip into and say, "This is something appropriate to the children I am teaching at that time."

26. Is it not extraordinary that in a situation where science teachers are scarce, overloaded and not updated, that every school has to do its own validation of the material which arrives?

(*Dr Stephenson*) Precisely, so would it not be good if we had a system which did that?

(*Dr Peacock*) I have talked to a head teacher who said that so much arrives on his desk that if it has not got his name on it, he throws it in the bin; if it has got his name on it and it looks flashy, it goes in the bin; he then reads what does not look flashy and has got his name on. That is a fairly crude but reliable way of doing it. The material is out there, SETNET spends a lot of time in their 56 SETPOINTS throughout the United Kingdom linking in with schools on science, engineering, technology and mathematics, and there is almost no substitute for having somebody to talk to about whether a piece of material is relevant. It may be the head of department, it may be a teacher you meet in the pub, it may be somebody in your SETPOINT, but there is no substitute to be able to discuss what they have found out works. I am cautious about, but other people are in favour of, some sort of kite-marking scheme, on the grounds of what it can lead you into in litigation and other exciting things, and also ensuring a completely neutral judgment process, because the pressures which come on people to say schemes are good are quite phenomenal. I am not in favour of a kite-marking system as such although we can explore it, but I think getting better communication between the teachers and the suppliers and the local SETPOINTs is vital. We have a website which people can search on the subject which DTI and DfEE have supported us putting up. I cannot think of any other way of doing it than teachers getting other people's views on whether something is useful.

(*Professor Higgins*) I know the ASE is thinking about this.

(*Dr Moore*) I think it is a crucial point because I am quite convinced that industry needs the opportunity to explain to the education system what they are doing to bring people up to date. We are pretty sure that most of what is done is not read because people just do not instantly see what to do with it. We do provide reviews of anything which comes our way. There is a second point, and we would be willing to have a go at some form of kite-marking if only to exercise the process of judgment. We are convinced, certainly this is true in my ten years of experience, that if we want anything to be used by teachers, you have to sit down with them and work it through with them, you cannot just assume they will read it and get on with it. That can be done electronically but we are only at the edge of how that might work and there still has to be a dialogue. We have just closed our annual conference where we had over 3,000 science teachers and over 200 exhibitors in that dialogue process, but we still only have less than 10 per cent of the science profession turning up there, because the schools do not see the relevance and will not release their teachers. It is all part of the process, there are resources there but until we can persuade school management that this has a value it is going to be an up-hill task. The whole business of producing resources cannot be stopped and should not be stopped, but we do need to do the best we can to interpret what is there. I think industry does have a role to play too in helping to work with teachers to produce something rather than just assuming when they mail it to schools it will be opened.

Baroness Walmsley

27. There is one issue in relation to these, what I might call contributed materials which we have not mentioned yet, apart from the quality and the relevance to the curriculum, and that is the branding of them and the attitudes and opinions behind the production of these resource materials. I would particularly like to ask the teachers what is their attitude to that and whether they have the time to look carefully at these materials and to understand where the people who produce them are coming from, and whether that is appropriate in the classroom and what is the attitude of the profession generally towards these things.

(*Ms Strang*) I think it is quite a difficult question to answer. At the moment a lot of the material arriving at schools is simply not looked at because people do not have the time to look through it. It may well be that at a later stage in our development as a profession, when professional development has become more embedded within the work teachers are doing on a daily basis and it is more part of the culture, then maybe people will use those materials more readily. As for what lies behind them, I cannot answer that one.

(*Dr Stephenson*) Do you mean, if I show an ICI video, for example, am I concerned about the bias? Is that what you are asking?

28. Yes, I am just asking about it, I am not coming from one side or the other. As a teacher in the past I was only too grateful for good quality material which would provide a variety of experience to my pupils, whichever source it came from, but obviously one had to be very careful that it was not just propaganda for the company or organisation which was producing it.

(*Dr Stephenson*) Where I have had the time, yes, I have looked through company videos to identify any bits with propaganda. There is always an element of the company selling themselves but you can actually use that for a discussion about ideas about science. You have to be aware it is there and how you are going to tackle it, but that takes time.

29. Absolutely.

(*Mr Dillon*) There are ethical guidelines which were drawn up with the help of British Petroleum. My experience of working with different sponsors is that I have always been impressed by how careful they are to stand back and not have any editorial control over the tone or the content of the material, and that has generally been the case.

Baroness Wilcox

30. This is so interesting and I would like to say the questions as we have them are difficult to answer. Listening to the head teacher and the head of department, if I had had one of you teaching me science at school, wouldn't that have been nice! What we are listening to here is the best and I have to say that I do not believe that science is taught necessarily to the level which we are hearing today and I do not think the provision nationally is as good as it could be, for all the reasons you have explained. Therefore I think the Government is pressed from all sides to try and bring up the level of the bad schools as well as the good schools. My question should be put in that context. Following from questions you have had before, are some, at least, of the materials you get co-ordinated with the national curriculum? Should they be? From what I hear today, it does not sound like it. Do supplementary materials cater for children of all abilities? Obviously we are concerned that all children should leave school without science being such a mystery to them and being dropped so early. It seems to me that these resources are very important, obviously not for people like you but certainly for some of the teachers who do not have the subject information that you describe so well as being essential to doing the job well. I think we would lose half the science teachers in the country if you had to put them through that. Could you answer my question in that context?

(*Professor Higgins*) First of all there is a question about the relationship to the national curriculum and Justin will be able to answer that.

(*Mr Dillon*) It has generally become the case that the materials are prepared in such a way that when that sorting and sifting process goes on they are directly relevant to the national curriculum, because otherwise people will look at them and say, "I cannot use that, I do not teach that now, I will put it away." There are some exceptions to that and there is some very good material which enriches and goes beyond the national curriculum.

(*Dr Peacock*) I think the market place was ruled by that particular issue because those which did not have any relevance to the national curriculum did not get used, and the person who created them inside the company usually got—well, a comment made about it. So there has been a trend over about a four or five year period. Four or five years ago there was a lot of rubbish out there but it has got a lot better and I think you can be assured of that. May I just address an issue relating to that? There is a balance. I am saying I want information so that people can make their subject relevant to the world they are in, and clearly relevant to the world they are in is some of the things made and done in industry. There is a balance and I do not think it has got out of hand. I think there is always an intellectual fear it gets out of hand, but I have seen not that much rubbish where people have been trying to promote their company.

(*Professor Higgins*) I would like to come back to your point which I think was implying, could the material that is out there help in the schools where the teachers are not as good as they might be? I think our view is that you have to do something about the teachers. All the best material in the world is not going to be a great deal of help to a bad teacher. I do not know if Kay wants to comment on that.

(*Dr Stephenson*) Basically what I have said before. The material is there, it is how well it is used that is the point. The quality of some material still needs to be improved but it is how well it is used and how well our teachers are trained to make use of it and apply it to the children they are having to teach.

31. Does that therefore answer the question that these materials cater for children of all abilities? Are you are saying that the teachers themselves sift and try to use what they can for children of mixed abilities?

(*Dr Stephenson*) Ultimately I would say that is every teacher's job anyway because as a trained teacher you would expect to understand the pupils you are teaching and how you manipulate the resources you have got to suit those children. But that comes back to the training of teachers and the continuing professional development of teachers.

(*Ms Strang*) I think that more could be done with the production of materials from outside, but I think probably what needs to happen is that there needs to be a closer working relationship with some of the industries involved in producing this material and the teachers in schools. I think probably on a local level quite a lot can be done, for example, a group of teachers working together with people from local industry producing an education package which might include a bit of video, a bit of written material, it might be on the net. I think things could be done at a local level where teachers work together and I think that might address the problem you were talking about, the quality of the profession right across the country and some teachers being much better than others. We need to actually raise the level of the lowest. I think that sort of approach can be very, very effective rather than a company which is very divorced and separated from schools producing material which lands on my desk or the head of science's desk and we have never had anything to do with it or been involved in its production. So some local groups could be helpful.

(*Professor Higgins*) I think that picks up an extremely important point which came out in our discussions with teachers in the report. Part of the report was based on focus groups and teachers said that it was such a rare chance they had to talk to teachers from other schools about their subject. There is an overwhelming desire for teachers to talk to teachers about the best way to deliver a material but that brings us back to the timing factor. You have to release the time, somehow, for that to happen. There is a great deal which will happen through peers working together if it can be allowed.

Lord Jenkin of Roding

32. Can I take this a little wider? In the note we had about your evidence this morning it was said you were interested in pursuing issues pertaining to science in schools which were raised in the *Science and Society* report which I chaired. One of the passages of evidence we had in that was based on the proposition that the curriculum has not really changed since science became a compulsory subject

Lord Jenkin of Roding *contd.*]

up to 16. The point being made, and really it picks up the point Lady Wilcox was asking about, is, how much of this is still aimed at able children who it is hoped will move on to A-levels and careers in science? To what extent is the material which is available and the teaching which is available aimed at the wider question of generating an understanding of the history of science, the scientific process, so that people can achieve what we were told they could achieve, "a scientific literacy" or, as the Americans said, "science for citizenship"? Is this a subject which this sub-group is likely to want to concentrate on?

(*Professor Higgins*) Our starting point was not actually, can we produce more Nobel Prize winners, it was, can we produce scientifically-literate citizens. That is what the country needs and what the science education system has to deliver. It will inevitably, if it delivers scientifically-literate children at that age, also deliver some Nobel Prize winners, we believe, but the key is the education in science. We deliberately did not ourselves address the national curriculum because there are other areas where it is being addressed, but I know that Key Stage 3 is being addressed at the moment. Maybe Justin can give us some input in what is happening on that.

(*Mr Dillon*) Speaking in a personal capacity, one way to alienate science teachers is to change the curriculum rapidly, so the Government's notion of stability in the curriculum for a five year period was a good strategy. Now is the time perhaps to go back to some of the arguments which came out of the *Beyond 2000* report which looked at whether there should be a curriculum perhaps for those people for whom science will be a vocation and a curriculum for those people for whom science would be part of their everyday lives except they will give it up formally at the age of 16. The Qualifications and Curriculum Authority, the QCA have been looking at the curriculum for the 21st century and will report this year on possible strategies for some changes, so that the science curriculum reflects modern science and also the needs of the whole population rather than the minority.

33. The report talked about a dual role, and I think it is very encouraging, I must say, what Mr Dillon has just said, that this now is being looked at. I personally was very attracted by the *Beyond 2000* philosophy, one might say, and I am delighted to know that is now going to be followed up. It seems to me we had so much evidence saying that the problem of engaging with the public, which is what we were really about, was made much more difficult because so many children are put off science in schools and never feel they want to relate to it again.

(*Mr Dillon*) In Japan, where I was fairly recently, the Government has decided to radically restructure the curriculum in science and has reduced the science content to make it more appropriate to a wider range of the population. There has been a lot of teacher resistance to this to the extent that teachers may take the Government to court for reducing the amount of content. This may be the case in this country. If you make broad changes which would reflect some of the philosophy of *Beyond 2000*, maybe teacher resistance and university resistance would change. It is a change which many of us think is necessary.

Lord Jenkin of Roding: We did refer to that point. We recommended a gradual approach and Lady Platt was very keen to see that went into our report. So we accept that.

Chairman: Lord Patel, do you think your question has been covered?

Lord Patel: I think it has been covered, yes.

Chairman: Can we move to Lord Perry then?

Lord Perry of Walton

34. I think this has been covered as well. So long as there are so many teachers called on to teach any subject they have had no basic training in, is there a need to have special materials for them which are different from the ones which are made for the teachers who have had training? If so, who should do it? The implication of the question is that it should not be the expert who writes these materials for the non-expert teacher, it should be generalists. Who are they?

(*Professor Higgins*) I now understand the question, I did not fully understand the question before.

(*Dr Moore*) I think the resources are there but in many cases it is the question of whether the teacher has the time to sit down and work through them. I do not think they need to be particularly interpreted. I think a physicist is perfectly capable of picking up chemistry from the resources available, it is a question of time and the need to do so. I think many of the issues dealing with the day-to-day, "How do I cope with my next lesson", do not require special interpretation in that sense, because we are dealing with people who are already scientists *per se*, who are extending their range of knowledge. The question is how that is best done. Courses have been provided, the Open University provided quite a number of conversion courses over the years, which were not widely taken up, and my judgment would be that a teacher would be reluctant to spend a year on a training course before they got round to teaching because they have been put into post to do it that September rather than a year down the line. So we need something which works on almost a lesson-býlesson basis. I do think that is already around if teachers are encouraged and enabled by having the time to do so.

35. When I was running the Open University we actually did not make the professors the chairmen of the course teams. We got people who were not the real experts because you are teaching people who are beginning the subject without the usual background. It is the same sort of problem, is it not?

(*Dr Moore*) I think one of the dilemmas is that people do come from different backgrounds. I have a proportion of chemistry in my degree but no biology. In a sense we are all different and one of the problems is that you cannot meet every individual need.

Lord Wade of Chorlton

36. We have touched on this a little but I would just like to enlarge this slightly. Is there a system of best practice for asking teachers to teach outside their area of specialisation? Taking up the point Lady

Lord Wade of Chorlton *contd.*]

Wilcox and Lord Jenkin referred to, I am concerned that the negative attitude towards science in many parts of society today could very likely be generated from some teachers, non-scientific teachers, putting over a philosophy that is anti-science. I wondered how much your investigations have suggested that is the case and, if that is the case, is there anything you feel we can do about it?

(*Professor Higgins*) Can we take that in two parts. I think Juliet could talk a little about how one copes with the mixture of teachers in science. There is no system, I think is the straight answer, but there is certainly plenty of good practice, and we were hearing about some of that.

(*Ms Strang*) On the last part of your question, which is are there some teachers who are putting across a very negative attitude towards science, I do not think we have got any evidence about that, and I do not think we can comment on that. Different schools approach this in different ways, and there are obvious examples of best practice, but there are not any systems in place that are adopted by all schools. Some of the examples of best practice would be to ask teachers to work in teams, for each team to have a subject specialist—say, a biologist, a physicist and a chemist—and, for example, to ask each teacher in that team perhaps to teach only one subject outside their main specialism, and for the teachers to work together in planning their lessons and in planning their approach to the curriculum. That would be one example of best practice. I am sure that guidelines could be produced for schools. Obviously schools are also having to manage day-to-day situations where they may not be able always to implement best practice, but they can certainly try, and obviously ideas about this can be shared between schools.

(*Professor Higgins*) Picking up on that, we also feel strongly that exactly that sort of activity, that good practice, is part of management. This is where the middle management—the heads of departments, the heads of schools—need training and need skills, they need to be able to deploy their teachers in a way that allows them to develop new expertise at a rate that does not sap their confidence. So all of this is precisely good practice. I do not think it would necessarily be sensible to have a system, because each school would have a different group of people and a different set of personalities, but the training to deal with it, I think is crucial. This ties in with management training, with CPD at the management level and the leadership in schools. In answer to the last part of your question, I am sure we have no direct evidence that teachers in schools are creating an anti-science culture, but there seems to be considerable evidence that there is at least an anti-science concern in the country. It is very interesting, because at the same time it goes with an intense curiosity about science, particularly amongst children today. I do not think we have any evidence that teachers themselves in that subject would be either creating or fostering this.

Lord Jenkin of Roding

37. We had evidence from the Royal Society of Chemistry when they did their Huddersfield experiment and they talked about the extraordinarily negative attitudes of some of the primary school teachers towards the industrial exploitation of chemistry.

(*Professor Higgins*) That is right. It is there in society, so it must be there in the teachers; they are part of society, I think.

Chairman: I am sorry if I seemed distracted a moment ago, but it is amazing how often contemporaneously with this Committee something is going on in the other place which is absolutely to do with us, and I see from the monitor that the Minister is talking about teacher shortages. It is quite bizarre how often that happens. Lord Patel.

Lord Patel

38. Thank you, my Lord Chairman. I would like to go back to this effect of improved CPD. We heard a lot about how it would be a benefit if there were a better quality CPD. What I would like to ask specifically is whether there is any evidence to support the view that the retention of science teachers would be improved, or for that matter the recruitment of them? The second part of the question is that I do not think we had the opportunity to go into the details, but how would it benefit the pupils? Is there any evidence that that would increase the uptake of science up to A Level or beyond by the pupils?

(*Mr Dillon*) On the first part of the question, I do not know of any real evidence that the more high-quality in-service education training people get the more likely they are to stay in the profession, but I think that it is a hunch that it is likely to be the case, and I think most of us would agree that that is where we are coming from here. We think that if you offer a professional an opportunity to enhance themselves, to develop their subject knowledge, to develop their teaching skills throughout their career, they are more likely to see goals, and more likely to see some feedback and some reinforcement, and they are more likely to feel that they are making some progress, especially if that is matched with some reward and some opportunity for development. The second question is about raising attainment. Some of my colleagues who are working on the Cognitive Acceleration through Science Education (CASE) project, which is a two-year departmental-wide in-service programme focusing on developing scientific thinking which develops a whole department, have found that that results in significant gains compared with control groups not just in science but also in maths, so the evidence is that proper classwork and professional development does raise attainment in science.

(*Dr Margetts*) There may be no specific correlation or evidence produced for teachers, but there are for whole other classes of people in the country, whether they work for companies or other professions, which actually demonstrate a very close correlation in recruitment and retention to individual and personal development.

39. In these other areas, what other motivating factors are there, apart from just improvement in training? You mentioned industry, but the chances

Lord Patel *contd.*]

are that that goes with an increase in remuneration too, does it not?

(*Dr Margetts*) Yes, certainly money and career opportunities are major factors, but personal development is a very, very strong element as well. I put those three as the primary ones, and personal development in terms of job satisfaction is probably the strongest. Whilst money does not always satisfy, personal development is actually the strongest motivator.

(*Professor Higgins*) Having done something similar in my level of education at the university, participation in the scheme, the discussion with other people, is actually very enjoyable; it is an enjoyable process if it is working well, and I think that is part of the attractiveness of university life. People enjoy the discussion, they enjoy the feeling they are on top of things and sharing it with other people, so there are altruistic and enjoyment elements as well as advancement.

Chairman: Now let us turn to this question of working out what happens.

Baroness Walmsley

40. I would like to move on to the issue of how we audit the quality, quantity and benefit of CPD. Any of us who have ever taught have plenty of experience of both good and bad courses and packages. As I recall, it is very much a matter of hearsay that "This course is good and that course is bad." Could I ask you, does anyone currently audit CPD in schools to ensure adequate provision? Does anyone audit the progress of teachers who receive CPD? Have they genuinely benefited from that experience? If so, who is it? If not, how do you envisage that such an audit might constructively take place?

(*Professor Higgins*) I think the answer is no to begin with, but perhaps David would like to comment.

(*Dr Moore*) It is quite clear that there is no audit. I think one of the comments we have been trying to make to you is that the professional development is limited, it is patchy, and therefore it is actually quite difficult to measure whether it has made a difference or not. Anecdotally, in our first pilot, our 20 teachers that we had go through, by the end of the year two of them had been promoted and two of them had left the profession. I do believe that it is crucial that we do carry out such a measure. We really are at the beginning of this sort of process, I believe, and we certainly think, that it has to be demonstrable that it is making a difference, and I believe that none of that is taking place at the moment.

Lord Jenkin of Roding

41. One is tempted to say that perhaps they came on a course because they were due for promotion.

(*Dame Bridget Ogilvie*) Coming back to the small programme on CPD in primary schools,[1] where we have carefully audited the effect of introducing CPD into about 15 groups of schools around the country, the effect was enormously to enhance the self-confidence of teachers. That is a very important issue. Again, at the anecdotal level, some of the teachers who were lucky enough to have this benefit got promotion more quickly, and unquestionably the pupils benefited. That information is available; it is on a small scale, but it is, may I suggest, rather interesting.

Chairman

42. Are there any other ways in which you can audit the process, apart from this?

(*Dame Bridget Ogilvie*) I think the key issue is what is happening to the children. This is what we are all about, actually. By helping the teachers and making them more self-confident and better able to deliver their task, the children will benefit, and in the end that is what we hope to achieve.

(*Professor Higgins*) It is undoubtedly true at the moment what is measured in schools is output not how you get there. There certainly should be questions asked of each school, "What do you have in place? What are you doing?" At the moment you are not asked what you are doing on CPD and there is no reason why schools should not be asked when they are inspected, it seems to me.

Baroness Walmsley

43. I wondered if Dr Stephenson feels auditing the quality and benefits of CPD is a key function for heads of department?

(*Dr Stephenson*) It would certainly make my job easier if I knew what was going on was good quality, because as the manager of that CPD I need to have confidence what I am delivering to my colleagues is quality, yes. It is all about confidence that you are moving people on, that nobody is standing still and what they are delivering is quality.

(*Professor Higgins*) We did mention in the report the Institute of Learning and Investors in People is one way of looking at it, and of course the Centre of Excellence could well be one way of giving essentially an overview of quality of CPD. It is not a fully-answered question but, yes, it needs auditing.

Lord Wade of Chorlton: Surely the best audit would be to see how science in this country develops in the future? You will know whether you have been successful or not by whether we can retain scientific development in the way we ought to be doing at the moment. I get very worried when I see scientific investment moving to other parts of the world where it is more enthusiastically encouraged.

Baroness Warwick of Undercliffe

44. I wonder if I could pick up Dame Bridget's point about pupils. You have expressed in your evidence particular concern about Key Stage 3 and it has come up in several of the points you have made. You do say in your memorandum, Professor, that the pilot phase of the new initiative on science has started. You obviously feel that is very positive. Is the lack of progress in Key Stage 3 a problem for all

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[1] *Note by witness*: This programme was funded by AstraZeneca Science Teaching Trust.

Baroness Warwick of Undercliffe *contd.*]
pupils in all subjects or is it a particular problem in science? How best could it be remedied?

(*Professor Higgins*) I think only three have been essentially measured.

(*Mr Dillon*) The evidence is that attainment at Key Stage 3 Science was lower than expected compared with other subjects, so science has been the one which has been picked out as of particular concern. There are some concerns about mathematics and literacy and those have been addressed by Government initiatives. We do not know about the other subjects, is the answer.

45. What about the remedy? Let us take it there is a particular problem in science, what about the remedy?

(*Mr Dillon*) One of the problems is that given limited resources, schools are going to focus on Key Stage 4, because it is the Key Stage 4 results and the GCSE results which are part of the drivers of the system. So there is going to be some lag before Key Stage 3 improves, so it will be interesting to see how the Key Stage 3 initiative develops. Nevertheless, the success of the numeracy and literacy initiatives offer some positive thought.

(*Professor Higgins*) What we have seen of the initiative in Key Stage 3 seems to be going in the right direction. Would you agree, Justin?

(*Mr Dillon*) I think it is too early to say.

(*Professor Higgins*) From what I have heard discussed it looks as though they are addressing the right questions.

Lord Quirk

46. In a way this leads back to the issue of the curriculum again, does it not, because part of the problem, as Dr Moore points out in his paper, paragraph 1, the nature of the curriculum, of getting people to go on through Key Stage 3, which is the drop-out stage, into Key Stage 4 may well depend upon developing a curriculum which is more understood by the pupils to be aimed at the majority rather than hoping to trawl for the next Nobel Prize winner in N years' time. I wonder if, Chairman, David Moore is able to say a little more about that particular area and indeed whether the implications are not only for the school curriculum but possibly even the university curriculum for the teaching of science?

(*Dr Moore*) It is certainly true that we are trying as a Government initiative to address the issues in Key Stage 3, and those are focused at the moment more on "how" than the content. It is also true, as we have said, that the curriculum authority is looking at a revision of that curriculum to address those issues. We also have a Year of Science coming along and we are hoping to use some of that to re-vitalise the curriculum at Key Stage 3. It has been static for a long time and I think the issue therefore is relevant. At Key Stage 4 there is a driver for individual students to pass examinations and that in a sense is working. I do think you have issues at A-level and university about content and delivery in the same sort of way as you raise expectations lower down the system, so it is a broad approach. I cannot comment particularly on the university level but I do get the impression that should be addressed in the same way we are looking at the issues in schools.

Chairman: One of the things which drove me into science was the terrifying bangs which I think now would be banned in most school laboratories. Lady Walmsley wants to talk about practicals.

Baroness Walmsley

47. Yes, thank you. I think most of us would accept that practical experience of science is not only a good way for people to learn it but also sparks an interest and an enjoyment in science in young people, so I would like to ask about practicals in schools. Do you have a view on the ability of schools to provide good practical science demonstrations and is there enough of it going on? I notice at the end of paragraph 2 of Dr Moore's paper some concerns about the fact that health and safety issues may be affecting teachers' willingness to undergo the very difficult job of controlling a classroom of young people doing a scientific experiment. What are your views about the fears about health and safety regulations and potential litigation changing school practice?

(*Professor Higgins*) Kay should come in first as she is at the coal face.

(*Dr Stephenson*) I believe that actually very little is banned in schools. A lot of it comes down to the confidence and the competence of the teacher in the classroom actually doing the practical demonstrations and managing the student practicals. We are going through the process in my school at the moment of training a biologist to teach chemistry and she is working beside a colleague who is teaching her how to teach practical chemistry and it is hard work because she has no background. You need to train your teachers to understand the risks and assess those risks and then be able to do practical demonstrations safely. There is nothing better in the classroom than a safe, well-done practical demonstration for delivering science. I do not think, actually, an awful lot is banned, it is just you need to do a risk assessment and be able to do it competently, and that comes down to training.

48. Is the feeling that things are perhaps not banned but that people do not have confidence actually affecting the quantity of practical work done?

(*Dr Stephenson*) Yes. This is anecdotal but talking to other people at conferences, groups of chemistry teachers, they tell me that such-and-such an experiment is banned, and I say, "No actually, it is not, it is just you need to look carefully at the level of risk associated with it."

Chairman

49. Is there a special difficulty in biology, do you think, given the greater difficulty in access to animals? I remember when I was at school one had a whole range of dissections one could do on a huge number of different species and one really saw working biology in a way which I think our school children now cannot do. It was certainly extraordinarily exciting. I do not suppose we can go

Chairman *contd.*]

back to those days but is there a problem with the issue of dissection?

(*Dr Moore*) I believe there is. There is certainly a reluctance amongst the students to participate in that and there is much less of it going on. Possibly the school teaching profession is responsible for decimating the frog population. There has to be a balance and I think children are allowed these days to opt in or opt out and whether they want to participate in it. I do not think we are constrained in that sense but the whole business of regulations about caring for animals, looking after them in holiday time, all sorts of things like that, have made it less prevalent than it was perhaps. Coming back to the broader question, I think there is no doubt the existence of health and safety legislation and the awareness that you may be sued or taken to court is a significant factor, so if people are doubtful then they may choose not to do it. It is clear in our view that practical science is still safer than being out on the playing field or in the gymnasium, there is no question, but there is an attitude of mind which says, "If I get this wrong, I may get sued." I think the Health & Safety Executive have a responsibility to treat this with a gentle hand rather than with the same application they give to a large industrial process because our track record is good. I am conscious that we have probably dealt with no more than three cases in the last ten years where we have had to support a science teacher. At the end of the day, that is a very small number when you think of the number of lessons around, but there is undoubtedly a culture which says, "I probably can't do this", and it is done because they have not read the regulations carefully enough or they have not the confidence to go on. I do think the Health and Safety Executive should contribute to making life easier for teachers.

Baroness Platt of Writtle

50. Could I add to that, is there also a problem over expenditure? If you are doing practical work you are actually using up resources from the school, whereas if you are teaching a humanities subject, if you have got the books, the paper, the speech and so on, the revenue you expend is not so vital, is it?

(*Professor Higgins*) I think that is true.

(*Ms Strang*) Yes, it is true, because it certainly costs a lot more to run a science department than a humanities department, or at least a science department gets extra funding, it gets more money, to run itself. I do not think that is a significant factor. It is not a significant factor at my school or any other school that I have worked in, that money has limited what has actually happened within science lessons—I think probably much more so the confidence to conduct practical experiments, and not only that, but to use practical activities as a good means of teaching particular concepts of science. There is a lot to know about how you actually take a practical activity and help children actually understand the concept that you are attempting to demonstrate, explain or explore through the practical. That is crucial and that is part of the skill. So sometimes practicals take place, but the children do not always learn from those practical activities. That is a bigger issue, I think, than the cost, for example, of practical activities.

(*Professor Higgins*) I did a quick trawl through my relatives most of whom seem to be teachers and their colleagues. The confidence factor was the most important one, and also confidence that if something did happen your senior management was going to support you. That was a point that was raised, that you trust your senior management to be behind you and to support you, which is part of the same thing. Also the time resource. There is a shortage of technicians in many schools, and I think that is also a problem.

Baroness Platt of Writtle: That is probably related to pay.

Chairman

51. Where do the visits to industry and the field trips fit in with the practical problem?

(*Professor Higgins*) Do they? Can they?

(*Dr Stephenson*) They do happen, yes. It gets more difficult to try to arrange them, and I think that since the introduction of the modular system at AS and prior to that at A Level, that has made it more difficult to find the time to take the children out of school, certainly at that level post-16. Below that, again it just seems to come down to having the confidence to go out and take a group round, and having a local link, somewhere that you can take them to. But they do happen, certainly in the schools that I am aware of.

(*Mr Dillon*) If I may, I would like to reinforce a point that Juliet made about the role of practical work as it is carried out at the moment in English schools, in that if you look at international comparisons of children's process skills, if you compare Singapore and England, where the attainment is similar and significantly higher than most of the countries in the world, Singaporean children do far less practical work than English children. It is possible there may be an argument that we spend in English schools too much time on practical work and not enough time on thinking about science, about the factual content of science.

(*Dr Stephenson*) I would like to chip in there. Correct me if I am wrong, but I think that of the actual children doing the practical work, a lot of children do useless practical work. A well-run demonstration that delivers what Juliet said—good-quality understanding—cannot be beaten as a way of delivering science, and I think we have to be careful that we understand what we mean by practical science.

Chairman: It happens in universities too.

Lord Wade of Chorlton

52. Some more than others.

(*Ms Strang*) Perhaps I could add one final point to that. Interpreting evidence, looking at evidence and making sense of that evidence, is one of the most difficult concepts to teach in science, I think you will find. When children do practical activities, that particular concept always come to the fore and it is one of the most difficult concepts to teach and one of

Lord Wade of Chorlton *contd.*]

the challenges for the science teachers. That is the point I would make there, I think, because most people will look at evidence from an experiment and will not necessarily take note of the evidence in front of them, but rather stick to the original ideas that they may have had without that evidence. We see that all the time on a daily basis. This is what we are talking about when we talk about the understanding that the general public have about scientific evidence. You see that on a daily basis in a school science lesson, and it is a challenge for science teachers to get those ideas across and to help children understand.

(*Dr Moore*) Speaking absolutely personally, I think this is the best chance we have had in ten years to get a bit of lift into science teaching. I am interested in fizz, but we are much more interested in changing teachers' practice, so we see this as a great opportunity to try to do things which will be continued year on year on year. One of the dangers of previous Years is that they have not always had lasting impact. We want to try to change practice during the course of this Year. Everybody who is involved has that same intention to make it something significant which lasts.

Baroness Platt of Writtle

53. Does the Council have a view on what would be best to make 'Science Year' a really important event for the whole of society, not just for the teachers obviously? Should it be targeted at teachers as well as pupils—and the world as a whole, I suppose?

(*Professor Higgins*) I think generally, yes. The teacher who would have been with us, except that she is looking after a new baby, made a remark at our presentation in November. She said, "Why does it have to be 'Science Year', why not 'Science Forever' or 'Science Always', why just 'Year'?", that it should not be just a year. We think it is a terrific opportunity that we must not allow to go wrong. The last thing we want is a 'Science Year' that falls flat, because that would be a disaster.

54. What is your advice to make it fizz and not go flat?

(*Professor Higgins*) I think it has to be directed at teachers as well as children, and it has to be directed at the general public as well. The schools are a good way of engendering the enthusiasm. Bridget, do you have any idea of how this should happen?

(*Dame Bridget Ogilvie*) As it happens, many of us are going on to a meeting, which is ongoing at the moment, to discuss what 'Science Year' is going to do. It has not been formulated yet, but I think many of the key bodies that are represented here will be involved. We all agree, I think, that it is crucial that this Year is a success, and that it is not just a year, that it has a long-term effect supporting all those causes that we have been discussing here today.

Chairman

55. Thank you very much indeed for the very succinct and lively answers to our questions. We have actually managed to finish more or less on time. I do not know if there are any burning issues you feel we have not covered?

(*Professor Higgins*) We had a list of our five most important points and I have ticked them off as we have been going through and we have essentially covered what we think is key. Can I reiterate a point I made during the discussion, which is that everything we have talked about is geared to the children and their entitlement to have the best possible science education. That is what we feel is important, this relationship between understanding science and being a good citizen in a democracy. This Government is passionate about transparency and openness, it says, there is a continuing debate in the press about transparency and openness, well, you can have as much transparency and openness as you like but if the population does not understand what you are telling them—and in science we believe it does not—then the citizen is not actually able to exercise that democracy. We believe that doing something about education through CPD is a way to make sure these children have the best possible education. So that is really our bottom line and our vision.

Chairman: Thank you very much indeed to all of you for coming along.

TUESDAY 23 JANUARY 2001

Present:

Flowers, L.	Tombs, L.
Howie of Troon, L.	Walmsley, B.
Jenkin of Roding, L.	Walton of Detchant, L.
Lewis of Newnham, L.	Warwick of Undercliffe, B.
Platt of Writtle, B.	Winston, L. (Chairman)
Quirk, L.	

Examination of Witnesses

MS ESTELLE MORRIS, MP, Minister for School Standards, examined; MR RICHARD HARRISON, Department for Education and Employment, and MR IAN BERRY, Department for Education and Employment, called in and examined.

Chairman

56. Thank you very much for coming to our Select Committee on Science in Schools. It is a subject that comes up with great regularity in the Science and Technology Select Committee, as you know. It forms an important aspect of our considerations on science in society. We believe that it is very much one of the core issues in public understanding. We are very grateful to you for coming today. The first thing is to ask you whether or not you have anything to add to the memorandum that you sent to us?

(*Ms Morris*) No, except just to thank you for this report. I am delighted that in your original report you did focus on science in schools. I do not wish to add anything to the memorandum but there are things I wish to expand on and discuss in response to questions from the Committee. I would sooner leave it that way.

57. Would you be happy if we go straight to the questions we tabled for you? The memorandum is supportive of science teachers. I suppose the first thing to ask you is what you feel are the key issues coming out of the report of the Council for Science and Technology.

(*Ms Morris*) I think it really highlights something that I am afraid is endemic in teaching, and has been for ages, that I do not think we have done well enough by the profession as far as professional development is concerned. That is true of science teachers and it is certainly true of all teachers. The work that we are doing now is starting from a very low base. I also think it really emphasises the choices that teachers make about their everyday work and how they allocate time and resources. What has been said in the past is that decisions have not been taken by schools and individual teachers or by government and local authorities to prioritise professional development. Therefore the end result is, and I think this is what came out of the report most strongly, that we do not have as effective a form or method of financing professional development as we should have and there is a long way to go. Those are the main lessons I learned. Sadly, they were right in that there is a long way to go. Some of the issues that they raised are ones that we have been considering over recent years and are just about to put in train now.

58. When do you expect that the actions which are being taken by the Department will start to have an effect?

(*Ms Morris*) There is a lot of difference between developing policy and implementing it. You have to watch the pressures on teachers and the time of the teachers. If you were actually to look at the professional development we have done on literacy and numeracy with primary teachers at key stage 1 and key stage 2 teachers, you would see that that is having an effect already. By any standard of measurement, that is having an effect. It took a year for that to have an effect. One of our challenges is to make sure that, as we implement policy at school level, we are mindful of the pressures and demands that puts on schools and individual teachers. Quite simply, you cannot do everything at the same time. When we look at professional development, there are already results beginning to come through. Our challenge now is nothing less than changing the culture. I know this will come in a response to later questions. I think it will begin to have an effect when we have a proper system of performance management in schools, when teachers are confident in identifying their own needs for professional development and the funding goes to schools in a way that makes sense to teachers, so that they feel they have resources actually to fund the development that they need. Being an eternal optimist, having put those in train for this year, I hope we are going to see some effect next year. I would not pretend for a minute that it is the effect and scale that we need to see in the medium and long term.

59. Do you want to address the issue of the practicalities of performance management briefly? We are seeing this more and more in a whole range of different public services, and for example in the health service. Do you think there are lessons to be learnt because sometimes so-called performance management can be quite unwieldy and ineffective. Would you like to address that?

(*Ms Morris*) It can be. I think the education system is incredibly complex and there are 24,000 schools, all of which have been told to run their own show. They have their own bosses, their own head teachers, their own governing bodies, their own targets and their own finances. Actually managing that as part of a cohesive education service for England is quite

Chairman *contd.*]

complex in terms of communicating the rest of it. It is true that some schools have excellent performance management systems and others have none. What we have tried to do is to adopt a framework that says: if what you are doing is good and you know it is good and OFSTED says it is good, we do not want you to change. What we have tried to put in place with the other schools, and it will only be starting this year, is the framework which they can interpret according to their own needs. There are some barriers to overcome. I taught for 18 years myself. I stopped teaching in 1992. In all the years that I taught I struggled to find the time when anybody came to watch me teach and then gave me an evaluation of that lesson at the end of the day. I taught in a very good school with good middle and senior managers. Historically we are coming from a culture of teachers who are not used to being observed in terms of their teaching and then analysed with a suggested way forward. That is the first barrier to overcome. The second barrier to overcome is that, in order to give teachers confidence that being observed and criticised, both positively and negatively, means something, you have got actually to say at the end of that performance management: there are resources at your disposal to train you to overcome your weaknesses. That joined-up system of being observed, being analysed, setting objectives for the next year and having resources to help you meet those objectives, are not standard in schools. Performance management is quite simply that: open to observation, opportunity to discuss it with your line manager, clarity of objectives for next year and resources to train you to meet those objectives. That is all we are asking for really in each of our 24,000 schools.

60. Do you see that performance management being part of the role of the headmaster? In other organisations it has meant drafting in extra staff to do the performance management.

(*Ms Morris*) The head teacher has got to take ultimate responsibility of the school and making it sure it happens. Line managers, middle managers and departmental heads who see teachers teach on a regular basis are probably the ones who support the Head in carrying out that task. In our best schools, and there are very many of them, I think the good departmental Heads see to their responsibility to observe to observe the teachers teaching at some point in each term. I now meet an increasing number of Heads who can say to me with confidence, "In every school year I see every member of my staff teaching". If you can get that embedded as a proper use of departments' time and head teachers' time, I think we are half-way there. The challenge is that it is not happening in enough schools. It can happen but the direct answer to your question is that it has got to be the Head who makes sure it happens. My own personal view is that that should be something that they are able to delegate and share with middle and senior managers.

Lord Flowers

61. Does this mean that the schools are going to be flooded with non-teaching supervisors?

(*Ms Morris*) That is a challenge for many departmental heads, certainly at secondary schools but less so at primary schools. A lot of the departmental heads have non-teaching time and they see it as a proper duty to use some of that non-teaching time in terms of observing teachers teach, not for a whole lesson but for a half hour or whatever they think is appropriate. What is true—and I hope we get a chance to touch on this later on—is that, in order to free teachers to observe other teachers teach, not as part of performance management but as part of professional development, you have to get somebody to take the children and to teach the children. Our best schools are finding the resources within the school budget to cover internally. What has inevitably happened when that is not the case is that you buy-in supply teachers to come in and teach the children. Everybody has to make a judgment as to when a child has had enough with a supply teacher and you ought not to do it to them again.

Lord Lewis of Newham

62. You are addressing the question of how to teach. How do you deal with the question of what to teach?

(*Ms Morris*) I suppose that is a very sensitive one for the Government in terms of what to teach. That is why we have the Qualification and Curriculum Agency and it is right that we should do that. You probably know that we have just reviewed the National Curriculum. There has been a review of the content of that curriculum. It is that balance again. We do not want constantly to turn over what schools are being asked to teach because, the minute they have bought the books and done the training, somebody comes along and changes the syllabus, which is hugely frustrating. I am more for evolution than revolution as far as the curriculum content is concerned but I think we will always want the QCA to keep their eye on the latest developments and in science probably more than any other area content has to be updated continually. I suspect, that even though we have just gone through the National Curriculum Review, in which there are some marked changes to the curriculum, the QCA and its committees have even today an eye on what is happening for the science curriculum in the 21st century.

Baroness Warwick of Undercliffe

63. I wonder if I might pick up the point you were making about middle management because it is one that has resonance with what the CST told us about their targets for continuing professional development, that the responsibilities on middle managers in schools have increased. I think obviously, though we did not explore performance management with them, they are thinking about this as well. Have you targets for concentrating on those middle managers? Are there guidelines that they all have in order to be able to judge reasonably uniformly the performance of teachers? Are there ways in which they are helped to make those judgments?

(*Ms Morris*) Yes. We are just introducing a national set of standards against which teachers can

Baroness Warwick of Undercliffe *contd.*]

evaluate their own performance as they move through their careers. In the old days, and not so much the old days, ten years ago or even five or six years ago, you did your initial teacher training and there was not even a curriculum for that, believe it or not. You obtained your qualified teacher status, and that was it. You then were not required to do any more training or get any further qualification from then until the day you retired at 60 or 65. I am not going back more than five or six years ago. What was put in place first was the NPQH, National Professional Qualification in Headship. We had a set of standards at the other end of the profession. What we have been trying to do over the last three years is to fill in the bits in between. What we have now is a situation in which, when teachers leave initial teacher training, they carry with them a portfolio of their strengths and the areas that need to be addressed. They now go into their induction year, which has only been introduced in the last three years, and there is a set of standards at the end of the induction year which they must meet. You are probably aware that, as part of performance management and performance-related pay, we have introduced a threshold assessment, which is about seven years into teaching. That is being introduced this year. There is a set of standards there. Already we have: QTS, induction, threshold and NPQH. What we want is for teachers to go through their career and at whatever stage they are at, including subject leaders and heads of department, to be able to look at a set of standards and evaluate their own performance but to use those standards to evaluate the performance of teachers as well. Otherwise you will have people in schools making different judgments about what level the teacher is at. We have begun this and we are all learning; we are learning and the teachers are learning. That is our aim, to have a non-burdensome set of standards that will serve the profession right the way through their careers.

64. Is your target middle management? Is your next main priority middle management?

(*Ms Morris*) Yes. You are right in saying it has been a long-ignored section of the community. We have not developed it yet. The other thing that we want to do, and you might want to talk to me later about the National College of School Leadership, is to move so that we acknowledge that leadership is synonymous with headship; they are not just one and the same. Leadership is about anybody who has responsibility for leading any areas of the curriculum. What we are asking the NCSL (National College of School Leadership) itself to do, and it has only just been set up and it has not even got its building up yet, is actually to look at the needs of middle managers. They may very well recommend to us, building on the qualifications for NPQH, that we do have a set of standards that can be utilised.

Chairman: Let us turn to the CST report.

Baroness Platt of Writtle

65. In paragraph 49 it shows a wide variation in *per capita* funds for schools for the purposes of CPD. Then, given this variation, do you think it is possible for equitable and effective CPD to be determined and addressed locally? I may say that I am prejudiced in favour of putting it locally because I am a former chairman of an education committee. Certainly in Essex we did a lot of continuing professional development, particularly I remember for the School Maths Project, to update teachers. I wonder whether you have circulars going out and guidance for teachers. When you refer to it, and you say you want to see it done locally in paragraph 15 of your report, you talk about a Standards Fund but I do not know what that means.

(*Ms Morris*) I pondered over those figures in paragraph 49. I am not for a minute saying that they do not affect the way teachers feel about the amount of professional development money. I did ponder over the difference in resources available to teachers in schools. What happens at the moment with the Standards Fund is that money goes directly from the Department via the local education authority into schools for a whole series of initiatives. It includes basically most or all of the money put out for professional development. All our money for literacy training and numeracy training and key stage 3 training will go through to the Standards Fund, but also money for extra teachers to meet our class size pledge goes thorough the Standards Fund. The Standards Fund has significantly increased in size over recent years. It is £2.9 billion for next year. That has increased quite a bit. When it gets to schools, we have been under this tremendous pressure that if we want to make sure that the training happens, the way we can do it is to ring-fence the money and say: "You cannot use it for anything else". Then we get terrible criticism for being too prescriptive and not leaving Heads to make their own decisions. We try to weave our way through the minefield. We are terribly prescriptive on literacy and numeracy. There is no choice: here is the money, you are not going to spend it on anything else because we have said so. We have been proved right on standards. What we tend to do with the rest of the Standards Fund money is to leave it to schools to spend as they wish. I wonder whether paragraph 49 reflects the decisions taken by Head teachers in schools, because we fund them through the Standards Fund on a *per capita* basis according to the number of pupils. That accounts for the difference in figures. I think what happens is that some schools then make decisions; the Head might make the decision as to how to spend the money or they might say to the teachers, "Let us talk about the decision about how we spend the money". The difference is in perception. It is not that the money has not been spent on professional development but the perception of the teachers about how much control they had over how the money was spent. We want control over the money. Local authorities want control over the money. Heads, middle managers and teachers want that as well. Getting that balance right is very difficult. As a government, we do not actually divide it and say: this is the bit that the teachers must have control over.

66. You emphasise, and rightly, that literacy and numeracy are important. But this particular report is about science teaching in terms of continuing professional development, and you mentioned yourself the fact that a teacher can stay in a school

Baroness Platt of Writtle *contd.*]

and not get any CPD for five years and by that time their science will be very out-to-date perhaps in terms of modern developments. The other side of the penny I believe is that there could be CPD for teachers in, say, history and modern languages to put some science into their teaching, too, in order to make sure that science is seen as a broad subject and not very narrow.

(*Ms Morris*) I think you are right. I suppose it is priorities. We made no secret that we were going to prioritise literacy and numeracy in key stages 1 and 2. When you prioritise, it is a choice that is a consequence of prioritising something and that something else does not get priority for the years in which you do that. It is interesting, and I am sure you have looked at the key stage results, and we were particulary pleased about those. You know we have really good results in literacy and numeracy but, just to draw to your attention to that, we have even better results in key stage 2 science. In 1997, when literacy and numeracy started, the key stage 2 science results were 69 per cent. They have actually gone up to 85 per cent, which is better than for literacy and numeracy. I think what OFSTED said is important, and it is what we believed: enhancing basic skills of primary school children actually meant that we saw an increase in standards across the curriculum. It has certainly been evidenced in the key stage 2. If you look at key stage 3, to which I know you want to come on, it has not happened there. There have been disastrous results for key stage 3, which is why we are concentrating on key stage 3 as part of moving the standards agenda forward. You are right. In time, when we have really embedded literacy and numeracy, I do very much hope that primary schools will be able to focus on science knowledge or knowledge in other areas of the curriculum, but we could not have done it altogether. I will defend to my dying day our decision to actually do literacy and numeracy. I think that was right. I also hope that it will happen eventually with key stage 3 science as well.

Lord Tombs

67. To go back to the question of the variation in expenditure between schools, which is a factor of 10; you are saying that that may be the function of the Head or the Head and the rest of management. Is there any scope for the local authority intervening in that allocation? Do they allocate in a way which gives them discretion as well?

(*Ms Morris*) Yes, but not much. You are probably aware that one of the drives of the Government is to make sure money gets through to schools. I believe that local authorities have a vital role to play in supporting professional development and in lots of other areas as well in terms of the standard agenda, and they have got to be funded for it. We are at the moment when we ask local authorities to put 75 per cent of the money through to schools in delegation. Although we route the Standards Fund money through 150-odd local authorities rather than direct to the 24,000 schools, it actually has a message on it that gives them fairly clear instructions as to how much should go through to schools. I think I am right in saying, that 75 per cent of Standards Fund money goes straight through to schools. So they could give more but they cannot give less.

68. Is that a global sum that floats directly through the local authority or is it INSET and CPD specific and earmarked as part of that?

(*Ms Morris*) It is separate. There are a number of strands. The money that goes from central government to local authorities, as part of what we call the standard spending assessment, is part of the council pot, if you like. They can choose to spend that on social services or transport or filling holes in roads. Our battle is to make sure they do not do that but that they put it into education. I pay tribute to local authorities for making that decision very well over the last three years. The Standards Fund money cannot be spent on social services and mending holes in roads. It is actual money that is part of the Government's Education Budget and not the schools' budget. So it goes to schools separately. When a head teacher or a governing body come to look at the finances at the start of the financial year, they have the global amount that came through SSA but separately they have the Standards money as well. The beauty of the Standards Fund for us is that it cannot be spent on anything else but education.

69. Within that earmarked Standards side, is there scope for varying the amount of expenditure on INSET, for example, or CPD?

(*Ms Morris*) Yes.

70. By the local authority?

(*Ms Morris*) No, by the head teacher.

Lord Quirk

71. It is clear from your opening statement, Minister, that CPD applies to the entire profession and not just to science teachers. Clearly our job here is to examine the science side. It was the job of the CST working group to highlight science. Are scientists a special case and would you see a possible danger in focusing upon the needs of science when other teachers in the profession may well say, "The resources are going to the teaching of science when we need them, too"? Taking Baroness Platt's point, of course, science changes a great deal more than, say, history or modern languages or whatever the other subjects are. But as the NUT said in their response: we do not want to get so hooked upon science teaching that we ignore the rest of the profession and possibly even alienate others in the profession. I wonder in that connection whether, given the fact that advanced skills teaching is a qualification and a career development right across the board, you might see that the proposed centre for excellence for teaching science also be extended across the board?

(*Ms Morris*) Professional development is a professional right, no matter what subject area you teach. That has got to be top, middle and bottom line really. Any professional has an obligation and a right to update his or her skills. As a personal view, I can quite see that scientists might make the case that their content knowledge changes and needs updating more than content knowledge elsewhere. I do not

Lord Quirk *contd.*]

think I can argue against that. That is not to argue that historians or geographers do not need also to go back and have the chance to keep up-to-date with the latest academic thinking. That needs to be evened out. I do accept that science teachers most definitely have the need to keep updated. In terms of the centre for excellence, one of the difficulties is time. Where do teachers find time to actually go back and update themselves on latest developments? Sometimes, if you do not watch it, you spend all the time you set aside for updating yourself trying to find a way through all the documents that have been sent your way to update you. All you do is sort the papers on your desk and you have not learnt much at the end of the day. That is where I think the centre for excellence can be particularly helpful. I know it came from the CST and we are keen to work with them on that and have agreed to give initial funding for that to see if we can get that up and running. If you piece that together with what the National College for School Leadership can do, what I am looking for is some leadership in the education service for managing and enabling teachers to access the opportunities that there are for updating skills. The opportunities are there and there is some good quality stuff but really there is no broker in between the professional development that is available and the teachers who need to access that. It might not be a very good term to use, but I think the excellence centres and the NCSL could be brokers; they could actually make access from the teacher to professional development far more manageable. It is not up and running yet. It will be and, hopefully, certainly teachers will be able to get the benefits of that in the next couple of years. I suspect that you are right, that teachers struggle at the moment to manage to access the developments there

Chairman: That seems to lead on very well to Lord Walton's question.

Lord Walton of Detchant

72. Minister, you have of course commented to some extent upon the costing of continuous professional development. When we met the CST working group, they thought that effective CPD would require a minimum of two hours per week of non-contact, non-teaching time, and perhaps up to five days a year. An estimate suggests that this might cost on average £20,000 per school or £100 million per year country-wide. I appreciate your concerns about ring-fencing, which governments do not like. I appreciate that teachers might regard it as being also over-prescriptive if you identify specific grants for this purpose. From my experience in the Health Service, there was a time when local authorities used to have a specific, identified sum for postgraduate training of doctors, just as they have a specific identified sum for research and development. I am not certain that happens now as much under the Health Service trusts, but is there not a case for identifying separately the funds that are allocated for continuous professional development in schools to avoid the inequalities to which Lord Tombs has referred?

(*Ms Morris*) There is a case for that. Probably there is a stronger case for that than there is a case for doing it in terms of non-contact time each week. I read that in the evidence that you received. I am not convinced. I will tell you what will happen. If you say to teachers, "We are going to give you two more hours non-contact time a week", with the best will in the world there is no lever for making sure it is spent on professional development. It could just as legitimately be spent on marking and preparation. Those are things that need to be done. It could be spent on talking to the department head about managing the department in the future and things that need to be done. If you did that, then to check that it is spent on professional development would create a minefield of checkers going around to see what the teachers were doing in non-contact time. I do not think that is right. You have a point. I do not know if you are aware of a small pilot we are running this year. We have said to ten local education authorities and to every teacher in that local education authority, "You can have £500 for professional development this year". If it is a teacher who serves one of our most disadvantaged areas, he or she can have £700. That is the first time anybody has actually said, "Look, there is an amount of money. Spend it on what you like. You can put it towards the certificate the ASE are trying to set up; you could employ a supply teacher to cover your lessons so that you can go and observe someone else teach". I am interested in that. It is not a global sum. I can give you the global sums. I can say £2.9 billion for the Standards Fund. There is a way forward and we are experimenting by actually saying to Mrs Smith and Mr Brown in the classroom, "This £500 is for your control. No one else can tell you how to use it. As long as it is roughly on something which you can justify as professional development, it is yours as to how to spend it". This is only a small pilot but, when we come as a government to respond to our consultation on professional development, which we will do in March, I think that is one of the things we will want to reflect on. If you had the money, and I am told by my officials that to do the two hours non-contact time is actually £80 to £120 million a year in teachers' pay, some serious thinking is needed about whether that is the best use of that money, not that I have got it. If I did have it, there would be some serious questions about whether that was the best use of it. I would go more for bursaries. I am more interested in that than in guaranteeing non-contact time.

Lord Lewis of Newnham

73. The bursary scheme that you are envisaging would be for a given school for all the staff presumably?

(*Ms Morris*) That is what our pilot has done over time.

74. How much would this cost to do over the whole country?

(*Mr Harrison*) As the Minister has said, £500 per teacher. With 450,000 teachers, that is £225 million by my quick calculation.

Lord Lewis of Newnham *contd.*]

(*Ms Morris*) That is only one bit. Competing with that are sabbaticals, key stage 3, literacy, numeracy and the new "A" levels and "AS" levels. I do not think that all the money ought to go on bursaries to teachers. In response to your question, if you ask me how can we give teachers most control and make sure that they feel that they can access CPD, I wonder if it is by giving them access directly to resources rather than non-contact time.

Lord Walton of Detchant

75. To follow that point up, surely if there is a well-established educational principle that one must define when one can the objectives and goals of any education process—that applies to postgraduate as well as undergraduate education—and if such funds were devoted to CPD, it follows that audit must be then carried out to determine whether those objectives have been achieved. Surely that is a way in which one could determine whether that CPD has been effective?

(*Ms Morris*) Yes, I think you are right about that. There is a move at the moment within the Education Department, because you have got to have that audit and accountability. The Standards Fund until this year had so many account forms to be filled in to get the money that sometimes schools wondered whether it was worth it, quite honestly. That was forms to get the money. We would like to move on. There are no forms to fill in this year. We have got rid of all the bidding in the Standards Fund and the money goes direct to schools. The relationship should be about outcomes. Professional development would come in within the relationship with the schools: "Look, here is Standards Fund money which includes money for CPD. What are the pupil outcomes at the end of the day?" The only way to reach those pupil outcomes is to enhance the skills of teachers and improve the quality of teaching. In order to do that, we have got to invest in their professional development. That is a nice little equation which is probably similar to what you are saying, but that has not happened yet. As part of performance management, if we as a government begin to agree with schools' outcomes and put pressure on the accountability of outcomes, that is a powerful lever to make Heads make decisions about allocating resources to professional development.

76. Outcomes for pupils but also outcomes for teachers?

(*Ms Morris*) Yes. They should be very closely linked.

Lord Tombs

77. Can I return to INSET, Minister? There seems to be some criticism from science teachers particulary that INSET is devoted too much to general administrative matters. I wonder whether you think that is inevitable. I have been struck by the drift of the discussion over the past few minutes, which seems to be separating CPD from INSET. Do you see that as a necessary course and, if so, is it because of control or initiative or what?

(*Ms Morris*) The different terms are interesting. I suspect that when teachers talk about INSET and administration, this five days a year when pupils are not brought into school, that is meant to be for INSET professional development. Possibly I should not say this and I might be criticised by teachers, but I think some schools do use that for administration, but not all. One of the things we are looking at is evaluation; it is not a threat to take it away or a criticism but to make sure that those five days are used effectively. The difference is that there are needs for INSET at lots of levels. I think schools, staff and the departments do have a need to get together to talk about the school's needs, but individual teaching teams and individual teachers have needs as well. I sometimes wonder whether there is that comment because that balance is still not right. If I go to a teacher and say, "Aren't you lucky. You have had all this resource for professional development through the literacy and numeracy strategy", they reply "You must be kidding. We did that because you said it". It is professional development. Because we said they had to do it, it does not count. What we have not achieved yet and what we are asking schools to do, and we are asking the General Teaching Council to work with us on this, is to identify what characteristics a good school has when they get that decision-making right, when they correctly identify resource and time for individual professional development, departmental needs, school needs and to answer the national agenda as well. That is right in our best schools but it is not quite right in the schools that need to improve.

Baroness Warwick of Undercliffe

78. The CST is about retention. The CST claimed that 30 to 40 per cent of new science teachers leave within five years. There is obviously a cost associated with that. I wondered if you had estimated what it was. Given what you said about CPD, do you regard that as an opportunity cost; in other words, that CPD might be something that one can balance against the huge cost of this very large turnover?

(*Ms Morris*) Yes, I do. There are a number of other things as well. The figures are not far from wrong in terms of turnover within five years. I am not sure that they are particularly worse for science teachers than they are for teachers of other subjects. I suppose also we are moving to an era when people do change jobs more. We have to bear that in mind. Certainly we do not want the teaching profession to lose this skill and expertise. The other thing to say is that interestingly where we are seeing an increase of people wanting to be teachers is actually with career changers moving into teaching. We have to be aware that the notion in teaching of going in at 21 and coming out at 65 is no more true than it is for other professionals in a changing world. We are very pleased by the number of career changers coming in at 30 or 40. I think you are right. Scientists particularly do have opportunities both in industry and academic research and at university. We have to face up to the fact that if we are competing with other employers who will offer better professional development opportunities and chances to research and chances to

Baroness Warwick of Undercliffe *contd.*]

enhance their own academic work and to work in better conditions, we are going to lose them. It is as simple as that. You cannot expect any more. That is why not only is professional development good for the children but I see it as one of the main ways of improving our retention. That is what is behind this. Something as simple as the £60 million we have made available to improve laboratories in secondary schools is about giving children better working conditions but it is about a clear message to scientists that their working conditions in schools should be enhanced as well. Retention is as important as recruitment. I am sure that professional development is part of that retention as well.

79. How do you factor that in when you are pursuing a balance? Is this an argument that you have to make separately with Treasury or an argument that you are making internally within the Department?

(*Ms Morris*) We are always asking for more from the Treasury and long may that continue, and long may they say yes. To give an example, the money that we put in for golden hellos and training salaries over the last two years, if I remember rightly, was subject to a separate allocation from Treasury each year, so there will always be that money but money for professional development tends to come to us as part of our main grant allocation to the Department from Treasury. Then we will make a decision as to how much of that goes into the Standards Fund for professional development and how much into other things. Within the Department it does have a high priority. I have become more convinced, having had the opportunity to do the job that I have, that the difference between policy-making, development and having an impact on anybody anywhere in the country is whether you get the implementation strategy right. I have decided that good government departments put as much emphasis on policy implementation as they do on policy development. That is a cultural change that needs to be brought about. Because we concentrate as a department on policy implementation, that gives us a lever to argue powerfully for money for professional development in schools. With that lever, the importance of implementation as well as policy development, we have been successful in securing so many skilled resources for CPD.

Lord Flowers

80. Minister, you mentioned cultural change and how right you are. If there is one thing we have learnt in recent years it is that science teaching in schools at all levels must be given in the context of a public understanding of science. That is a very big cultural change from what we had in the past. As a supplementary question, I want to ask you this. I am more interested in the education of teachers than in the education that teachers give because, if they have not been educated in science in the context of its public understanding, they will not then pass on the gut feeling that it is all about. True, they can be topped up a bit by CPD courses and things like that but that is all you can do about them. They were brought up the wrong way. What I am concerned about is that they are brought up the right way in future. Before putting the question, may I declare an interest? Two years ago I was Chairman of the Nuffield Foundation. Since my time, the Nuffield Foundation has put out a proposal for an "AS" level science course in the context of the public understanding of science. I read this with fascination and admiration and felt that if your teachers had been through that "AS" level course at that stage of their lives, how different things would be now for their gut feeling and understanding of what it was they had to pass on to their pupils. What I want to ask you is whether you or your officials are aware of that report and, if not, will you try to make yourselves aware of it? I would very much hope that your Department would take that report, or something like it, very seriously and try to develop a public understanding of science amongst school children who are likely to become teachers.

(*Ms Morris*) I am not aware of the report. I shall make it my business to become aware of it in the not too distant future. I think you are right. That is one of the reasons behind Science Year, which you might possibly want to go into with me. I have also been quite pleased when I have gone into primary schools. Clearly there has been a huge improvement in that science is now taught in primary schools. Primary schools do tend to capture that excitement, imagination and interest in learning that sometimes somehow for some reason is squeezed out the older the children become. I have seen seven or eight year olds with magnets or electricity and making light shine, and their faces shine as well. It is genuinely wonderful to see that happening in primary schools. I agree with you; it goes beyond teachers. Whereas many parents are happy to read with their children and help them with their English, how many of them feel confident about talking to them about science or some of the great moral issues that we face in society at the moment that are based in terms of science advancement? We need to get away from the idea that the only thing we need to know about science is science teachers. Science underpins much of the way we live our life at the moment. No doubt your report will help us.

Chairman

81. Just to pin you down on an earlier point, you mentioned about teachers coming in at a later age, and obviously that is interesting and good. There is also a very high turnover of science teachers. I wonder whether you would like to comment on the cost of that to the Department?

(*Ms Morris*) I am not sure if I have a cost for that. I suppose the cost of every one we lose at the moment would be a trainee teacher's salary of £10,000 if it was a science subject; that is for actually retraining them and whatever we put on the cost of training a teacher through initial teacher training. I am told by my officials that we allocate to initial teacher training providers about £12,000 to train a teacher and certainly for science teachers there is a £10,000 training salary. I suppose if we train somebody

Chairman *contd.*]

merely to replace someone we have lost, that would be £22,000.[1]

Lord Jenkin of Roding

82. I would like to come to the question of the supplementary materials and other services that are available and to concentrate particularly on the question of the National Grid for Learning. This was launched with a good deal of publicity and it tried to generate excitement. One of the things that we learnt from the CST is that it has had a relatively small use, much less than I think you and others had hoped would be the case. I wonder if you have any views as to why that should have been so and what could be done to put it right. It always seemed to me that in a modern world this is one of the ways you really can help to keep up-to-date.

(*Ms Morris*) Things are getting better. That is good news for the Committee in terms of the latest figures for that. You have to remember the starting point. I do not want to use too many statistics. In 1997 when the Government came to power, actually only 17 per cent of primary schools were connected to the internet and 83 per cent of secondaries schools. That is connected, not using it. They could have been connected for administration. Now we actually have 98 per cent of secondary schools connected and 86 per cent of primary schools and they will all be connected by 2002. That was the starting point. Most teachers are of my age group. If you look at the age profile of the teaching profession, these are people who sometimes lack familiarity with information and communication technology and certainly have not grown up doing their job as teachers based on ICT. Change is difficult for us all. There has been so much to do in three years: installing the broadbands, connecting to the internet, buying equipment and training the teachers. All that had to be done. In terms of the NGFL, the good news is that if you compare the figure, in November 1999 there were 2.8 million visits to the Standards' site but a year later in November 2000 the figure was 8.1 million. The figure has quadrupled in a year. My favourite statistic is that for Christmas Day; for last year the figure was 17,000 and for this year it was 21,000. Even on Christmas Day, access to the Standards' site actually increased. We are making progress. I need to explain that by saying that there were probably people connected who do not celebrate Christmas. I would not like to give the impression that that is all teachers do on Christmas Day! Going back to the culture point, it is about changing culture. I do not mind, as long as there is progress. A four-fold increase in a year is quite good progress. If you ask me whether it is now influencing everything that every single teacher does in the classroom, the answer is: no. This new generation coming up that is going through training now is so familiar and comfortable with this that, give schools ten years, and I think it will just become second nature to them.

Lord Flowers: We all have grandchildren and many of us can thoroughly endorse what you are saying.

Lord Lewis of Newnham

83. Is there any feedback from the actual schools as to how they find this particular combination? Is it meeting the needs of the schools? At the moments the schools are in a turmoil of alternative courses and alternative syllabuses which are coming forward. This seems to be one of the more effective ways of getting directly through the "AS" phase to this stage, which is bewildering to many people.

(*Ms Morris*) It is. You can see some really bad lessons with some of the most advanced ICT equipment in the classroom. ICT does not teach anybody anything. What is important is how the teacher brings together the traditional skills of teaching with the opportunities of ICT. I will give you one figure. If you ask schools themselves, over the last year, in 1999, 6 per cent of them said that they substantially used ICT as part of teaching science. A year later that is up to 35 per cent in primary schools. The figure was only 6 per cent for secondary schools a year ago and it is 49 per cent now. If we ask the teachers themselves, they will tell you that they are making more use of ICT. The NGfL site itself has grown so much and has so many pages that the danger is that you visit it but never actually buy anything because you cannot view the goods. My colleague, Michael Wills, has responsibility for the NGfL. "Teachernet" is a search engine for the NGfL. Instead of having to search it all yourself, it should guide you to the sites. If you want science, you can be taken directly to relevant information and resources. The truth is that we are getting better at managing the website. This has all happened in three years. It grew like topsy. The challenge with ICT is to get a support structure that manages the growth. With "teachernet" and the work that the British Educational Communications and Teacher Agency (BECTA) are doing, I hope I can promise that, as the months go by, it should be more manageable for teachers. I do know that they will use it but they will go back to the textbooks as well. I listen very seriously to what they say about usage and how much use they are making of it.

Chairman: We can quite understand your slight reticence about the age group to which you were referring!

Baroness Walmsley

84. Minister, although all schools have the internet now, many schools have a great deal of paper-based supplementary material coming their way. That continues and grows and it is not likely to stop just because we have the internet. How can the Government assist in the distribution of these supplementary materials and do you think there should be a national validating body looking at

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[1] Note by Witness: An estimate of the cost of a primary or secondary trainee on an initial teacher training course is £13,200-£16,300. For postgraduate courses, the average is between £10,900 and £12,400; for undergraduate courses, it lies between £17,600 and £24,100. There are additional costs through the new Golden Hellos for postgraduate trainees in shortage subjects (maths, science, modern foreign languages, D&T and IT) of £4,000 after entering teaching; and induction year costs for all new teachers.

Baroness Walmsley *contd.*]

quality? Would such a body also assist in screening out any corporate or single-interest promotion disguised as education material?

(*Ms Morris*) It is difficult for Government to comment on that as that gets into censorship, if you do not watch it. Some of the commercial stuff is very good; it is top quality. One of the things I have been impressed with in the years that I have been lucky enough to be in this post is that there is a lot of goodwill out there from people who are not full-time educationalist and they support schools in what they do. In a previous answer to the Committee, I mentioned that schools cannot do it all by themselves in terms of creating that culture of society understanding science. Those people, who are industrialists with a science base, have to help as well. I do not want to say that all commercial stuff is not good. I do not think it is the role of government to do that; otherwise, it does smell of censorship. I wonder whether some of the professional associations, such as the Association for Science Education could kitemark or give indications of good practice. I would much sooner leave it in the hands of the profession. That means either individual teachers making the decision or groups of teachers and professional bodies making the decision. We are giving money to the chemical industry. National Training Organisation (NTO). They are trying to map the paper information that comes from a range of organisations and see where the gaps are so that those can be filled. You are right that too much of it goes out of the brown envelope and straight in the bin.

Lord Quirk

85. Might the sifting be part of the role of the centre for excellence?

(*Ms Morris*) It could be, as long as it is done by the profession itself. I do not mean sifting so that it never gets to schools. The profession itself could look at how it advises schools about what is useful material.

Lord Jenkin of Roding

86. Could I draw your attention to the fact that when we did the Science in Society report we had a good deal of evidence from the learned societies and others. One of the things that stuck in my mind, and it is referred to in the report, was the Royal Society of Chemistry's Huddersfield experiment. The sponsors came away really quite depressed at the hostility of primary school teachers to the concept of chemistry in industry. It seems to me that there is a real hurdle to overcome here because of, and I use the word advisedly, "propaganda" which comes from some of the single issue groups. I think that is responsible for creating quite a lot of this hostility. It does seem to me that there must be some way of sifting, and you used the phrase "kitemarking", the material which actually reaches teachers on this issue and which can influence really quite adversely substantial numbers of children when, after all, the Government really does depend upon our modern, high-tech industries.

(*Ms Morris*) There are probably two types of information. As for the information that comes through from single issue pressure groups, teachers are fairly good at spotting that, and they would only use it in a carefully balanced way with material from another point of view. My experience personally as a teacher is that those are quite easy to spot; they are so blatant. There is a type of material that has good information from the industry. I suppose sometimes for hard-pressed teachers that comes through too quickly and there is too much of it all in one go. I sometimes say to industrialists when I meet them if they are keen to work with us that spending money on glossy leaflets and sending them through the post is easy but it is not the best use of their time and resources. Whereas there is an obligation on the education service, not on government, to guide teachers through materials and give them some help, there is an obligation on industry and those partners in the education service actually to talk to teachers about the best way to feed them information. I know that some industries have linked together the provision of written material with the opportunity for workplace visits or for members of the industry to come into schools. If you do that and offer a package, it becomes far more exciting. There is work to be done. Your ideas are very worthwhile following up. It is not only teachers that have to make sense of the information; there is an onus on scientists outside schools to question how they put information into schools. Dialogue between the two would be helpful.

Lord Howie of Troon

87. Minister, you mentioned the business of scientists and engineers coming into the school classrooms. The government has a swathe of initiatives directed to that end. Can you tell me how these are working, or if they are working?

(*Ms Morris*) There are far more than there ever were. It goes back to written materials. It was left to luck whether you had those good links with business in terms of visits to business and engineering works and people coming into schools. Some schools had that and some did not. A lot depended on whether a child in the school had a parent who was in the industry and made the link. That is nice but it is not good enough. In terms of education and business links, you will be aware that we reorganised Training and Enterprise Councils (TECs) into local Learning and Skills Councils. Within each local LSC area there, we have asked Education and Business Partnerships to work with the Learning and Skills Council and we are funding them to the sum of £5 million. There are many other organisations, like SETNET and those that have traditionally worked in science and engineering, which are almost free-floating. We have tried to get them to be partners in the Education and Business Partnerships so that they can offer a coherent package to schools. We want some mapping across schools to make sure that every school has an opportunity to gain from that experience. There has been some good stuff. I know the DTI has made £6 million available over the next three years to facilitate that very link so that people from outside schools come into schools and, more important than that, make sure that every child at every key stage gets a top quality visit to a place of

Lord Howie of Troon *contd.*]

work, whether it be engineering, business or science based. It is there but it is haphazard. With the Education Business Partnership and the Learning and Skills Councils and this money from the DTI, we are trying to make the best the norm, even though that is a simple phrase. If we can do that, we are almost there.

Chairman

88. Whilst we are on the subject, what about the issue of getting practising scientists into schools more often? Certainly my experience has been extremely positive. I think a number of scientists feel the same way. Would you feel this is a useful exercise? Can it be promoted and should it be promoted?

(*Ms Morris*) I think there should be some attention drawn to the fact that there is a programme called the "Researcher in Residence" scheme that is run by the Research Councils, and "Neighbourhood Engineers" run by the Engineering Council. People with expertise, just because they pay children attention, sometimes totally underestimate the impact they have on children. Many of our children will grow up in neighbourhoods and areas where they never meet an adult on a face-to-face basis and have a conversation. They never meet anybody who is a professional scientist or a professional engineer. They go through all their school days without ever seeing such a professional. The only person who has those skills that they may talk to on a one-to-one basis is their teacher. If we can get scientists into schools, the very fact that they are interested enough in the children to go there and spend time there gives a clear message to children that science is worthwhile and that they too can be a scientists. It is about putting into children's lives aspirations and goals and making them see that they can achieve the role of academic scientist or engineer. No one from their family or from their street has ever done it but they could do it because someone who was an engineer actually told them they could. We should be doing more of that. I would say that we need to be spotting quality all the time. In defence of my own profession of teaching, there are skills about transmitting knowledge to children and teachers do that very well. I do believe that not just any scientist can go and teach children. They might give a bad message. I believe strongly that by working with teachers they can bring their expertise and knowledge together in the schools.

Lord Flowers

89. Former pupils are particularly valuable.

(*Ms Morris*) Absolutely.

Lord Lewis of Newnham

90. May I return to a point that Lord Flowers made? It seems to me that one of the big problems we have is just how well equipped are primary schools, this is where it all starts, if the teacher is to be able to teach science. I am not at all clear how much is going on there. It does seem to me that there could be opportunities for teachers to meet dedicated scientists and ask them questions. I believe at the moment that they are listening to forces which are against science.

(*Ms Morris*) That is probably right. We now have a national curriculum for initial teacher training. You can at least say that the teachers who are coming into schools have covered a national science curriculum. There is a national science curriculum for primary teachers and an ICT curriculum. Most teachers are not just coming out of training; they have been teaching for quite a while. Apart from literacy and numeracy, I am aware of a scheme that is run for sports and PE. Many primary teachers lack skills in those subjects. That scheme is about training existing primary teachers to update their confidence and knowledge in those areas. Although I am not aware of a similar scheme for primary school science teachers, I know they can access professional development opportunities. One future agenda for those interested in science may be for us to look at how we do that more effectively than we are at the moment in primary school teaching. You are right to highlight that as a need. It is probably an area that is not yet fully met.

Baroness Platt of Writtle

91. I cannot resist doing a quick plug for WISE, Women into Science and Engineering, which does send into schools young women, and obviously young men are just as important. It is difficult because often they are bringing up a family and they have a career to think about as well. It can be offputting if very elderly engineers come in and may be sexist, I have to say. This is a problem but it does need considerable encouragement nationally in terms of money. We try to get money through the WISE budget but we are getting less and less money for WISE. Having made that puff, I just wanted to go on to question number 9 about many science teachers teaching outside their specialist area. A former member of this Committee, Lord Dainton, in the Seventies said this was going to happen and, my goodness, how right he was. Is there a recognised system of best practice for asking teachers to teach outside their area of specialisation? For example, are maths teachers asked to teach physics or are non-specialist physics teachers always drawn from biology and chemistry? We have heard this in evidence.

(*Ms Morris*) I suppose it depends on the schools. I would not pretend for a moment that sometimes schools do not have to ask teachers to teach outside their subject when they would sooner not. Anecdotally I suspect you are right, that maths teachers would be asked to teach physics, especially with the difficulty we have at the moment in recruiting sufficient physics teachers. I suspect that goes on. You will know better than I because you all have a science background that when you do a science degree you bring with your from your "A" levels and your degree work an understanding of science that goes beyond perhaps the title of your degree qualification. Certainly in initial teacher training that should be built on as well. For instance, if you have a chemistry degree, you are probably

Baroness Platt of Writtle *contd.*]

going to have to go and teach double science at GSCE and key stage 4. That is just part of life at the moment. It is difficult to answer the question. I do not want to pretend it does not happen and that everybody has exactly the subject background that Heads would wish them to have for a given group of children. Through a career, you might want to teach maths but part of your own career development sometimes is actually going on to teach physics. You will have the professional opportunity to do that. Given that it is no secret that we are short of science teachers, I suspect the premise of your question is right, that there is some cover going on that perhaps ought not to be developed. A 1997 survey showed that 95 per cent of those teachers teaching science have the appropriate qualifications to do that.

92. It is on the science side where you are getting the non-specialists. This is where, all right, as you say, scientists will have a basic knowledge but there is a need for in-service training to meet their actual demands within their schools, is there not?

(*Ms Morris*) Yes. One of the things we are doing at key stage 3 at the moment, as part of the pilot, is asking science departments to audit all staff members as to their skills and strengths in the department. These departments are then running professional development courses to help meet the needs they have identified. That is interesting. I suspect you are right in that some of the auditing that will go on will lead them to say that there are some areas of the science curriculum where teachers do not feel that they are up-to-date with the subject content. Apart from key stage 3 training, this applies not just in pedagogy but in curriculum content as well. If that has not gone on for years, we find ourselves starting from too low a base. On the one hand I say to you that this is being addressed and on the other that it has not actually fulfilled all that it needs to do at this moment in time.

Baroness Warwick of Undercliffe

93. You talked in your evidence about the excellence of the certificate in CPD delivered by the ASE in conjunction with the Open University. In fact, take-up of that course seems to be pretty low. You also talked also about the culture in the schools and the problems of time and so on. How might the enrolment in such formalised courses of CPD be more encouraged and how could the uptake be increased?

(*Ms Morris*) The take-up is low and I know that the ASE are disappointed. It is a very good course. It does all the things teachers want of professional development. It is classroom based; it gives teachers a chance to reflect on their own practice; it gives them a chance to look at other practitioners teach. If you look at whether it meets what they say their needs are, it does. I think it is a case of time. We all need to stick at it and make sure it continues to roll forward. I met with the ASE recently. I have not done this yet but suppose there were to be a spot check on a hundred science teachers and they were to be asked if they are aware of this course, I am not sure how many would say yes. I wonder whether what we need to do is actually address the way we communicate to teachers about the professional development opportunities that are available, rather than actually jigging the course about. I hope that does not sound complacent because it is not meant to be. I think it is a case of being patient while it works through. It goes back to the question one of my Lordships asked earlier on; it is about how we get that information to them easily and succinctly while they are doing a busy and demanding job. I think the centre of excellence might help as well.

94. One of the things that has been suggested to us is that there should be a national body, something like the royal medical colleges have, to set standards of teacher development and also to monitor the effectiveness of CPD provision. Is that something that is attractive to the Department?

(*Ms Morris*) It is something we should not rule out, given the stage we are at in looking at our CPD. We have asked the General Teaching Council, which I think takes up the prime responsibility for championing this on behalf of teachers of CPD, to do two bits of research with us at the moment to answer that question. The first is: why do people not go on a science course? One of the things we want them to do, as I said earlier, is to look at the characteristics of schools so that CPD is used effectively. Secondly, and I think more importantly: what are the best models of time usage in schools that show that CPD is accessed? If we can find that out, because there are many different models, we might be able to do what you want us to do more effectively without necessarily setting up a more bureaucratic structure such as an organisation. I think I have worked out the answer to the question now. We do that first and we see how that emerges before we actually look at setting up another organisation.

Lord Walton of Detchant

95. If you follow the medical colleges analogy, the General Teaching Council surely will have responsibility for setting standards of undergraduate education and also of monitoring the performance of the teaching profession. Do you see a role in this regard for the relatively newly established College of Teachers, which could well act as a body concerned with the development of programmes of CPD and monitoring their effects?

(*Ms Morris*) Is that the National College of School Leadership?

96. The College of Teachers has grown out of the College of Preceptors. It was established last year. There have been several meetings in this House about it. The intention is to try to develop a model along the lines of the medical royal colleges.

(*Ms Morris*) Rather than guess the answer to the question, which I do not have the knowledge in my mind to answer, I would sooner not comment because I am not sufficiently aware of the organisation. I can write you a memo on this, if that would be useful.

Lord Walton of Detchant: I think it is important because they have that idea very much in mind.

Chairman

97. The other thing that the royal colleges do of course is to have continuing educational credits. I do not know whether that system would be easy to apply to teachers because it is a different kind of development and about keeping up-to-date with new things. It might be true perhaps in science.

(*Ms Morris*) I am not quite sure of the relationship between the General Teaching Council and the organisation to which you referred. There seems to be some overlap. I will go back and find out about that.

Lord Walton of Detchant: The General Teaching Council, like the General Medical Council, is a statutory authority controlled by law. The royal colleges in medicine are in fact concerned with postgraduate and continuing education and they cover postgraduate qualifications, and so on. The intention of the College of Teachers I believe is to fulfil a similar role.

Lord Lewis of Newnham

98. My question is brief. I have talked to a number of teachers about this. There is clearly an enthusiasm for it. The real difficulty is, as you are aware more than I am, that we have so much to do anyhow in so many different directions. What incentives can we give? It seems to me that there is an incentive built into what we have just been discussing about the colleges. What real incentive is there to a school teacher actually to go along and take this course with the Open University?

(*Ms Morris*) What has been lacking in the past is a proper career structure for teachers. If you did not want to be a Head, to what else could you aspire? You could aspire to be a head of department but sometimes you did not want to do that; you wanted to teach and stay in the classroom. If you do not have those goals and aims, you remove the incentive to do professional development. That is not to say that teachers are not motivated to do development and be better teachers; I think they are. If you look at what has changed in the last three years, there are now: advanced skills teachers, and that carries a significant extra salary and status; the threshold assessment; and performance points above the threshold. There is more of a staged career structure. I am sure that has existed in other professions but is has never existed for teachers. If you hang on to that and remember what we were talking about with regard to performance management, that becomes the incentive to do professional development. You do the professional development because it helps you access promotion within your chosen profession. More than that, I want teachers to gain recognition and to be proud that they have passed the threshold, that they are an advanced skills teacher, that they work in a beacon school. The collegiate nature of teaching sometimes makes teachers generous and not claim individual credit for having achieved that threshold status. That is part of the culture change we need to bring about. The short answer is: the incentive is to progress the profession. The incentive to be better teachers on behalf of the children has always been there but it has almost been a selfless motivation and, in the nicest sense of the word, I think we need some motivation. It is about them, their careers and their esteem in society. That needs to happen more.

Lord Quirk

99. Does that mean that the Minister is implying, Chairman, that on the way to becoming an advanced skills teacher, CPD might be geared through a series of benchmarks so that, even without the substantial achievement of extra money through becoming an advanced skills teacher, there would be sufficient incentive, as Lord Lewis says, to pursue CPD by measuring achievement bit by bit?

(*Ms Morris*) There is a set of standards for advanced skills teachers, to which we referred earlier. At the end of the performance management cycle, at the end of the year when that teacher sits down with the Head or department head and works out the objectives for the next year, I would hope that a young teacher would be told, "I think you have it in you to be an advanced skills teacher eventually". The professional development for the next year could be geared towards meeting those standards. There is that progression through the structure. Hopefully, when we have the national standards at each of the levels, teachers will be able to refer to them and evaluate their own performance.

Lord Howie of Troon

100. In the engineering profession, which is the only one I know anything about, a graduate becomes a graduate member of one of the institutions, the appropriate one for his chosen calling. He then takes the examination and becomes a corporate member of the institution. After a bit, as he advances through his profession, he or she becomes a fellow of the institution. So there is a clear progression through the profession. The important thing is that each of these stages is related to the amount of money you can screw out of your employer. Do you need something of that nature in teaching?

(*Ms Morris*) Each of the stages in the career that we are putting in place—the threshold, performance points and advanced skills teachers—carries extra salary. That has to be so. If there was no more finance at the end, we would never ever bring about that change in curriculum and in the profession. We have tried to get that structure right. That argument has started and extra salary is available. Whether it is comparable with the engineering industry, I am not sure but there is extra salary.

Baroness Platt of Writtle

101. May I ask a subsidiary on that point? As Lord Jenkin will remember, we visited the Experimentarium when we were in Copenhagen on "Science in Society". There was a very enthusiastic director there who had taken the point that a great many primary school teachers are older women who did not have very good science teaching when they themselves were at school and therefore they lacked confidence. He did in-service training for teachers. We have very good places like that 'At Bristol' or the Launchpad in the Science Museum, in Edinburgh and all over the place. Could they do in-service training for primary school teachers?

Baroness Platt of Writtle *contd.*]

(*Ms Morris*) They do. We made some money, not a huge amount, available to museums and galleries about two years ago[2]. That is a hugely exciting agenda because you can actually access that through the internet as well. It needs to be developed more. I have not been to a museum or gallery for ages that has not had a pretty good professional development programme for teachers. That is really coming along.

102. You have got to make it fun, have you not?

(*Ms Morris*) Yes.

Baroness Walmsley

103. Minister, I would like to address the evidence that there is some lack of teacher confidence and fears about health and safety and litigation, and that those are limiting the amount of good, practical demonstrations and perhaps even supervision of practical work done by the children themselves in schools. How can this confidence in conducting demonstrations and supervising practical work be restored and do you intend to produce any guidelines on health and safety in the science classroom?

(*Ms Morris*) I picked that up as well, not least from a comment that Lord Walton made earlier on, that there is a hesitation. I need to say first that that practical work is absolutely crucial; it gives the excitement that we were talking about earlier. It is crucial right from five through to the end of life when you stop learning. We live in a society now where people are very worried about risk and evaluate it in a way such as: what is safe now? There is a whole debate about what that is. Our feelings as a department are probably that these teachers are over-cautious and over-fearful, given the regulations. What the law says is very sensible and should not stop any teacher actually carrying out the sorts of experiments that good teachers, who are properly trained, can carry out. If there is a job to do in terms of allowing them to regain that confidence, I think we can do that. A document called "Safety in Science Education" was published in 1996. I am told it is still relevant four years later. I might go away and have a look at it. I understand what science teachers are saying. I think they are over-cautious.

Lord Lewis of Newnham

104. I am a chemist. I must add that chemistry as it is being taught in schools at the moment, to me, is pathetic. It bears no resemblance to the chemistry that one was exposed to even 20 years ago. This position is now becoming more complicated. We have had a note from The Royal Society of Chemistry pointing out that this is going to be made even worse with the present regulations on waste. The new waste regulation will no longer allow us to mix the chemicals, as it were, with other types of waste. So there is now going to have to be a further measure taken within the schools—I am sure you are aware of this—dealing with this particular problem of the waste that you get, both with biological and chemical systems as a whole. This once again is a brake that you are putting on school teachers.

(*Ms Morris*) It is about getting the balance right. The Health and Safety Executive advises on health issues in schools. I am not a scientist. Like many, I have not studied science since I left school. I really would be hesitant to comment on whether that was a good move or a bad move. I am not in a position to say. I think we always have to take advice from the experts on that. I am not sure if I want to go beyond that. I trust that the Health and Safety Executive is discharging its responsibilities properly.

Lord Lewis of Newnham: Or differently?

Lord Quirk

105. Quite apart from the caution that is induced by health and safety fears, are there not problems also with the growth of sensibilities in relation to animal rights, for example over biological practical work, dissections etc?

(*Ms Morris*) I suppose there are. Compared to 30 or 40 years ago our classrooms have more children from different religious backgrounds and cultures and there are sensitivities. I think schools have to deal with that on an individual basis. That has to be a proper decision for Head teachers. What I would not want to do is to see that practical work taken away from the curriculum. To me, as a non-scientist, that is what science is about. It is about abstracting the theory from what happens in real life. Unless you actually see those experiments and things happening in real life, I do not know how you can ever study the theory effectively.

Chairman

106. Lord Lewis sees a problem in chemistry. I think there may be a similar problem in biology. It is my impression that a lot of young, potential, aspiring biologists are entering university with a less good practical education than they used to have. Some of this is due to sensibilities but I wonder whether part of it is not also due to lack of investment in the right facilities.

(*Ms Morris*) I think you are right about that. That is why we set aside 60 million for improving science laboratories. As science increases, you need modern facilities in which to teach it. Despite the fact that we made some money available for modernising laboratories, I do not think we are half-way there yet. I do not think we have reached the level of quality we want in our schools.

Baroness Walmsley

107. Is part of the hesitation the consideration of the numbers in the classroom? We know that class sizes have been increasing in secondary schools. Part of the worry about health and safety could be because teachers feel that they are being asked to control too many people in a laboratory doing things with glass, chemicals, pieces of biological material and so on. It is not just resources, is it, in terms of physical resources in the laboratory, but the number of pupils being supervised?

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[2] Note by Witness: £2.5 million was made available over 3 years from 1999.

Baroness Walmsley *contd.*]

(*Ms Morris*) It could be. I hope this will not sound flippant. I suppose you would need to ask the teachers what motivated them to do that. I will just air a bit of a political argument by saying that secondary class sizes only increased by 0.1 per cent between January 1999 and January 2000. Heads usually make decisions about not having science classes that are too big. If you go into a secondary school, you would see far more children in the English class than in the science class, and that is probably right. I am not sure that that is the reason. Most of our schools are already places where children behave well. OFSTED has said that time and time again. This is obviously something that has come to the attention of your Committee, as you have raised it. Despite what the rules and regulations say, your feeling is that there are fewer practical lessons being taken and therefore I will take that back and endeavour to reflect on it and see what information we can find.

Chairman

108. What about the support available for field trips? They can be extremely stimulating for children, particularly in biology, but I think probably in the other sciences as well?

(*Ms Morris*) I am not sure why they should have reduced in recent years. We have tried to arrange the funding through Fair Funding, which is a formula for allocating money to schools. Local authorities can have money for outdoor education centres and prevent them from being threatened. If you devolve all the money to schools, no one chooses to spend the money on buying a science centre. We did that to preserve outdoor centres. Is there evidence, Lord Winston, that field trips are diminishing in number?

109. I really do not know. I get that impression. My feeling is generally that there may be quite a problem in the public sector anyway.

(*Ms Morris*) That is interesting. We are getting far more out-of-school learning than there ever was before. There are: university summer schools where children are learning at universities about science; after-school clubs; Saturday morning clubs; and supplementary clubs. I would have thought that the number of hours children now spend in organised learning outside school is greater than it has ever been before, but that is not to say that your perception is not right. I do not have the figures to argue against you on that.

Lord Jenkin of Roding

110. A number of us have had a letter from your colleague, Jacqui Smith, about Science Year. This all sounds rather good. She said that you want to target 10 to 19 year-olds and the people who influence them. I know time is now very short but could you bring us up-to-date?

(*Ms Morris*) Yes. It is coming along very well. We have let the contract to the National Endowement for Science, Technology and the Arts (NESTA) to organise Science Year. They recently appointed a chief executive, Nigel Paine, who was the Chief Executive of the Technology College Trusts until he left that job and came to this one. We have allocated the resources. It starts in September. We are busy on the implementation stage. We have run two conferences so far with those who might be interested. We had an ideas conference earlier this month and we are taking plans forward now. We have an advertising campaign financed and almost ready to go; it is at least in the preparation stages. We are busy building up our allies, in the nicest sense, people who often carry status with young people and with adults. If they can talk about science and say that science is important, I think that will be very good. The idea is exactly what we were talking about earlier. It has to go beyond the science teachers and the child who is already enthused with science. It actually has to go as far as adults who are not in full-time education at the moment becoming more confident in talking about science. Just as we did with Maths Year 2000 and National Year of Reading, I hope, as we say, it will be difficult to escape Science Year once it is launched properly because it will be on television and radio. Going back to industry and commerce, and this is a positive invitation, all those who send the glossy information to schools I hope will also now sponsor this initiative as part of Science Year. I think it is going to be really good.

111. I hope there is enough time for you to get this all properly organised. This is only the beginning but time is short.

(*Ms Morris*) I have every confidence in NESTA, who put forward a good bid, and in Nigel Paine being able to sort this out. They have enough of a lead in time. No one ever works slowly. There will be pressure on them to get it done in time. Jacqui Smith and I are very happy at the moment with the progress that has been made. To use the wording from earlier on, we are quite excited by this. It really expands traditional teaching.

Chairman

112. Just one final, brief question. When do you intend to publish your own policy on the CPD?

(*Ms Morris*) In March.

Chairman: We are very grateful to you for coming and spending so much time with us this morning. Thank you also to Mr Harrison and Mr Berry. This has been a very helpful session.

Supplementary memorandum by Estelle Morris, MP, Minister for School Standards

Further to the oral evidence I gave on 23 January, I am now sending the additional information that I offered to provide.

Further to Lord Flowers question regarding the Nuffield Foundation and the AS level Science for Public Understanding (paragraph 80)

I was interested to see that their Lordships' Science and Society report referred directly to the Beyond 2000 paper produced following a Nuffield Foundation Seminar series and agree that it raises a number of interesting issues. I am pleased to see that the Nuffield Foundation is continuing to contribute actively to innovation in science teaching and is implementing some of the ideas developed in Beyond 2000 through its involvement with the new AS in Science for Public Understanding.

The AS Science for Public Understanding course offers an exciting way of teaching science in schools, using wider social, ethical and economic contexts to develop an understanding of scientific principles and their development. While the course has been designed primarily for use post-16, as part of our agenda to increase flexibility in the key stage 4 curriculum, from September 2001 schools will be able to meet statutory requirements for science at key stage 4 through delivering this course, although it does not meet the national curriculum programme of study in full.

We have asked the Qualifications and Curriculum Authority to consider whether the science curriculum meets the needs of pupils in the 21st century. As part of this work they will be using the experience gained from the implementation of this AS level in considering the feasibility of teaching and assessing similar material for pre-16 year olds.

Further to Lord Winston's question on scientists in schools (paragraph 88)

The Science and Innovation White Paper, published in 2000, announced a new Science and Engineering Ambassadors scheme to be launched as part of Science Year. This initiative will aim to build on existing schemes and will encourage young scientists to make links with schools. DfEE and DTI are working together to consider how best to implement this scheme.

Further to Lord Walton of Detchant's question regarding the College of Teachers (paragraph 95)

I have been very pleased to have an opportunity to find out more about the work of the College of Teachers. Clearly the College's focus on promoting sound learning and affording facilities to teachers to enable them to acquire a sound knowledge of their profession is very close to a number of initiatives that we are promoting, such as the National College for School Leadership and the Continuing Professional Development Strategy. I will ask my officials to ensure that they keep the College informed of our professional development initiatives. We would also be very interested to hear their views.

Estelle Morris

12 February 2001

WRITTEN EVIDENCE

SUBMITTED TO THE SCIENCE AND TECHNOLOGY COMMITTEE (SUB-COMMITTEE I)

Memorandum by the Association for Science Education

The Association for Science Education (ASE) welcomes the opportunity to contribute to the Short Inquiry into Science in Schools being undertaken by the Science and Technology Select Committee of the House of Lords. The value of the contribution that science can make to the education of all young people, as part of the school curriculum, is now accepted and is reflected in the status of science as a core subject. During the last decade there have been some notable successes in science education, most evident in primary schools and the performance of pupils in international tests. This is not a time for complacency, however, and the ASE with other organisations is working to improve the standards still further and to develop curricula that meet the needs of all pupils.

The plans for a Science Year (September 2001–August 2002), the development of the Science strategy for Key Stage 3 (KS3) and the discussions about the structure of programmes at KS4 all provide significant opportunities for taking science education forward into the 21st Century. Each of these initiatives in its own way will provide a unique stimulus to raise the profile of science, not simply as another subject in the school curriculum, but more importantly, as part of the everyday life and culture of this and future generations of young people. The success of the initiatives depends on sustained action which aims to build on existing strengths, initiate new developments and secure enhancements in the quality of science education. Against this background the Association would wish to draw to the attention of the Select Committee the following issues which need to be addressed.

1. The nature of the curriculum. Given the importance of science and technology in our way of life, all students should continue to study science throughout their school career to the end of KS4. In order to meet the needs of all students the curriculum must meet the demands of the majority, who will be consumers of science knowledge, rather than producers of that knowledge, as well as the minority of students who will continue to study science beyond school and move into scientific occupations. The ASE supports the work currently being undertaken by the Qualification and Curriculum Authority (QCA) to explore ways in which this can be accommodated.

2. Approaches to teaching and learning. The importance of appropriate approaches to teaching and learning has been fully recognised but there is much to be done to identify and support the development of effective strategies. Increasing pressures on teachers' time, and costs of meeting health and safety requirements cannot be ignored, and are cited as a contributory factor in reducing the number of live demonstrations of activities and restricting the level of practical work undertaken by students. Alternative methods can be used, but the important point is that the standard of the teaching must be paramount if quality learning is to take place. Good experimental work and valuable demonstrations have been abandoned by some teachers, who mistakenly believe that they are unsafe. This is generally not true.

3. Science in the primary school. The development of primary science over the last 10 to 15 years is widely acknowledged as a major success story and the quality of this achievement is internationally recognised. More recently, significant concern has been expressed, however, concerning the way in which time given to science in the primary school has been declining.

The success of primary science provides an excellent foundation on which curricula at KS3 and KS4 can be built. Further reductions in time would risk undermining the quality of science and therefore this should be resisted. Many teachers have found ways in which they can successfully integrate the work they do on literacy and numeracy with the science topics. The ASE would support such approaches, but argues that designated science time should not be reduced further.

The agenda implied by the three points set out above is substantial and the Association recognises that it cannot be undertaken lightly. It would argue very strongly however that the key element in ensuring the success of science in schools in the future lies in the need to improve opportunities for continuing professional development (CPD). This is not simply a call for more courses for teachers, rather it is a proposal for the development of a culture in which CPD is regarded as an entitlement and responsibility of all teachers.

Throughout its 100 year history the ASE has been working to support teachers to find ways of reflecting on and improving their practice. More recently it has developed and introduced a CPD programme which aims to support and encourage science teachers, particularly those in the early years of their career, to undertake their own CPD in a systematic way. The importance of CPD has also been recognised in the approach being adopted by the KS3 Strategy for Science, but there is still much to be done to improve understanding of the nature of CPD and what it means in practice. Industry can cite many examples of good practice, starting with "Investors in People" and leading to requirements of evidence for individual professional development as part of annual appraisals. There is little sign of this happening in a systematic way, or it being encouraged by school senior management. A whole shift in the culture in education is needed as a matter of urgency.

The ASE will continue to work to develop the quality of science teachers and teaching through appropriate means and would urge the committee to recommend further development of the CPD strategy.

Dr David S Moore,
Chief Executive

21 December 2000

Memorandum by the Department for Education and Employment

BACKGROUND

1. We welcome the Committee's interest in science in schools and we would like to thank the Council for Science and Technology for its report "Science teachers: supporting and developing the profession of science teaching in primary and secondary schools", published in February 2000, which offers a constructive and timely contribution to our work. Here, we outline how we are taking forward the Council's recommendations, under the six headings used in their report.

2. On 1 November 2000 we held a conference for science teachers to give them the opportunity to comment on the findings of the Council's report and to advise us on how we should take them forward. The conference also provided a forum for the Department for Education and Employment (DfEE), the Department of Trade and Industry (DTI), the General Teaching Council (GTC) and the Association for Science Education (ASE), all of whom have an interest in strengthening the provision of continuing professional development for science teachers, to exchange ideas. DfEE was represented by Jacqui Smith, DTI by Lord Sainsbury, GTC by Lord Puttnam and ASE by David Moore.

3. On 4 December 2000 the DfEE outlined how it was taking forward the recommendations of the report to a meeting of the Council for Science and Technology.

SUPPORTING AND DEVELOPING THE PROFESSION OF SCIENCE TEACHING. TAKING FORWARD THE RECOMMENDATIONS OF THE COUNCIL FOR SCIENCE AND TECHNOLOGY

General

4. We fully accept the recommendation that teaching should be a learning profession and we are keen to recognise and deepen the commitment to professional development amongst science teachers. To achieve this there are a number of existing and developing policies which are outlined below.

Induction for newly qualified teachers

5. We welcome the Council's attention to the needs of science teachers early in their careers. The Teaching and Higher Education Act 1998 introduced arrangements to provide all newly qualified teachers with a bridge from initial teacher training to effective professional practice. The induction programme provides well-targeted support in the first year of teaching, which in turn helps them to give of their best to pupils and to make a real and sustained contribution to school improvement and to raising classroom standards. It also provides a foundation for the newly qualified teacher's (NQT) long-term continuing professional development and career development. As such, it makes an important contribution to the retention of science teachers within the profession which, although no lower than for other subjects, is nonetheless a matter of concern.

6. The induction period combines an individualised programme of monitoring and support, which provides opportunities for NQTs to develop further their knowledge, skills and achievements in relation to the standards for the award of Qualified Teacher Status, with an assessment of their performance. It takes account of the NQT's strengths and areas for development as set out in the Career Entry Profile that each NQT brings from initial teacher training to the first teaching post.

7. The School Teachers Pay and Conditions of Employment document 1999 requires head teachers to ensure that inductees do not teach more than 90 per cent of a normal teaching timetable to allow their induction to take place.

8. We hope that through the induction process, new teachers will actively contribute to the development of good practice relating to Continuing Professional Development (CPD) in schools and that the Career Entry Profile will provide a framework for identifying development needs throughout their careers, DfEE, Ofsted and the TTA are all carrying out evaluations into aspects of the induction process.

Strategy for professional development

9. In February 2000 we published a consultation document on professional development. Our proposals related closely to the Council's recommendations and, as a starting point, we suggested the following principles:

(a) that effective teachers should take ownership and give high priority to professional development, and schools and teachers should share responsibility and commitment for development, supported by the Government;

(b) that professional development should be centred on raising standards in the classroom, and therefore take account of objectives to enhance pupil learning, as well as supporting broader professional skills such as working with external partners;

(c) that a wide range of development opportunities should be available, to suit different needs;

(d) that there should be equality of opportunity for professional development;

(e) that teachers should learn on the job and from the best, working alongside other professionals in the classroom;

(f) that continuing efforts should be made to look for better ways to use the time and resources available for professional development;

(g) that ICT should play a central role to support opportunities for self learning at times and places to suit individuals;

(h) that professional development should be high quality, and teachers and schools should be discerning customers;

(i) that good planning and evaluation are essential to make the most of professional development;

(j) that information should be shared widely about lessons learned and good practice, making the most of the potential of ICT.

10. Ninety per cent of respondents to the consultation agreed with these suggested principles and we are now moving forward to development a coherent strategy for implementation. This will both build on and draw together existing initiatives and will be developed through wide consultation, including the General Teaching Council, and subject associations. The strategy will be publicised in early 2001.

Key stage 3 strategy

11. In January 2000, David Blunkett announced that the Government would be focusing on raising standards at Key stage 3 as many pupils do not build on the early progress made at Key stage 2. The aims of the Key stage 3 strategy are to raise expectations, ensure progression, increase engagement and transform teaching and learning at Key stage 3. Comprehensive professional development and extra support for pupils below Level 4 on entry to secondary school are fundamental to the overall aim of the strategy.

12. Science was selected to be one of the five strands of the strategy for several reasons, including the fact that whilst there has been encouraging progress in numbers of pupils achieving Level 5 and above in science in 2000, there is still work to do to secure consistently good results. The strategy also recognises the need, highlighted in both the Council's report and the recent Ofsted report on Key stage 3 science, for Key stage 3 science teachers to have the opportunity to broaden and deepen their subject and pedagogical knowledge, which will help ensure that pupils' progress and learning in Key stage 3 science is improved. In addition, proposed new national targets have been announced for raising the attainment of pupils aged 14 by key dates of 2001 and 2007; the strategy for science at Key stage 3 will play a vital part in that agenda.

13. The science strand of the strategy will be piloted from the start of 2001, and the pilot will be used to develop the science strand for wider implementation at national level in 2002. School science departments within the pilot will be supported in Key stage 3 by the provision of high quality materials and a local support structure that will provide training and facilitate classroom based activities. The Key stage 3 strategy is designed to make a major contribution to the professional development of the great majority of secondary science teachers.

Association for Science Education's certificate of CPD in collaboration with the Open University

14. The Association for Science Education delivers a two year professional development programme which is targeted at science teachers in the early years of their career. The programme is almost entirely school-based with a clear emphasis on meeting the needs of the individual teacher in their own school. Teachers receive accreditation from the ASE and can choose to complete an assignment which contributes towards an Open University Masters degree. This is an excellent model for the delivery of science teachers' CPD and, as such, reflects the recommendations of the Council's report. We hope that the ASE will be successful in recruiting more teachers to this programme in future years, which is being part funded by both the DfEE and the Teacher Training Agency.

Leadership and Accountability for the CPD of Science Teachers

15. We accept, as recommended by the Council's report, that we have a direct responsibility for ensuring the delivery of national professional development initiatives such as the Key stage 3 strategy. However, we believe that it is more appropriate for school and individual CPD needs to be determined and addressed

locally. The CPD strategy will help schools and individual teachers make better decisions about professional development. In addition, the increased size and flexibility of the Standards Fund for 2001–02 gives schools more ability than before to determine CPD priorities locally.

Investors in People

16. As part of the CPD strategy we shall be encouraging more schools to become recognised as Investors in People and are both tracking and evaluating the impact of Investors in People in schools, as recommended by the report.

17. Investors in People can help schools to ensure that teachers and support staff are equipped with the skills they need to adapt and play an active role in building world class schools for our children in the new century. The Standard provides schools with a framework for developing all of their people so that everyone can make a contribution to school improvement and raising pupil achievement. Schools recognised as Investors in People say that achieving Investors status has helped them to improve their planning, and improve the status skills and motivation of all their staff, which ultimately has had an impact on pupils' achievements.

18. In England at July 1999, 1,849 (7 per cent) schools were recognised as Investors in People and a further 2,090 (8 per cent) schools were working towards the Standard. The latest data from Investors in People UK show that by March 2000, some 2,880 (11 per cent) schools had become recognised and a further 5,595 (22 per cent) schools were working towards the Standard. Our Investors in People in Schools Strategy has made a significant contribution to this 18 per cent increase in the take-up of the Standard by schools.

19. The National Foundation for Educational Research (NFER) was commissioned in August 1999 to review Investors in People take-up by schools and conduct case studies. We published the report with a press release on 30 June 2000. The key findings were that those schools that are recognised or are working towards recognition are receiving higher assessments of teaching quality at Ofsted inspections than schools not using the Standard.

20. Following a further round of competitive tendering, the Department has commissioned NFER to conduct a longitudinal study to track schools through the Investors process to identify more fully the contribution of Investors in People to school improvement. The report of this study will be available in October 2002.

School Management's CPD Role and Requirements

21. We fully recognise the importance of the role of both senior and middle managers in schools in creating an environment of effective CPD.

22. The new performance management arrangements, for which implementation began in September 2000, will involve an ongoing cycle of objective setting, monitoring and review. With the support of a performance management consultant, teachers will be asked to agree objectives each year covering professional expertise and pupils' progress. The annual review will provide an opportunity for structured discussion of teachers' work in the light of their objectives, recognising achievements and identifying areas for further development.

23. We are producing guidance for teachers on the development of a "portfolio". This will enable teachers to log their achievements and changing objectives and might also contain information about development opportunities and benchmarks of good practice. Alongside this, teachers will be able to consult a national standards framework, which will map out the progression possible in a teacher's career, such as induction, passing the performance threshold and Advanced Skills Teacher, in terms of the skills and characteristics they should expect to be able to demonstrate at each point.

24. In addition, the National Professional Qualification for Headteachers, which was launched in 1997, emphasises the importance of continuing professional development as an underlying theme throughout the course. This includes issues around recruitment, induction and the responsibility of continuing to develop staff throughout their careers. A revised curriculum for the qualification will be published in January 2001.

Beacon schools and Advanced Skills Teachers

25. The Beacon school and Advanced Skills Teacher (AST) initiatives were designed to raise standards through the sharing of good practice between schools. We fully endorse the Council's view that these initiatives will provide a significant contribution to science teachers' professional development, and their impact is being monitored.

26. There are currently 550 Beacon schools in England, of which 89 offer science and technology amongst their areas of expertise. The number of Beacon schools will expand to 1,000 by 2002.

27. Through work-shadowing, mentoring and the provision of in-service training, Beacon schools are giving teachers access to professional support and new development opportunities to enhance teaching skills.

28. Independent evaluation has indicated that Beacon schools are contributing both to overall school improvement strategies and to the continuing professional development of teachers. Evaluation undertaken by the National Foundation for Educational Research in 1999 showed that Beacon schools can be levers for change, acting as catalysts for debate, challenging others to review their own practices. Further independent evaluation is currently being undertaken by the National Foundation for Educational Research, who will report in the middle of 2001.

29. The Advanced Skills Teacher pathway offers teachers who want to stay in the classroom a new means of developing their careers without having to take on a management role. Advanced Skills Teachers (ASTs) are excellent teaching practitioners who share expertise with teachers in neighbouring schools—they spend around 20 per cent of their time on outreach, sharing their good practice in schools other than their own. They also often have responsibilities for developing staff, particularly NQTs, in their own schools.

30. There are nearly 100 specialist science ASTs in secondary schools. One of the consequences of the judicial review of the threshold arrangements has been to interrupt AST assessments: no new ASTs can be assessed until next year. However, after that point, we expect numbers of ASTs, including science ASTs, to rise significantly.

31. Those 750 teachers who have been successfully assessed as meeting the AST standard are already making an impact in their schools. OFSTED carried out an evaluation of the AST initiative in Summer 2000 and concluded that:

> "ASTs, where they have been appointed, are being regarded as key figures in school development and improvement. They are beginning to have an impact on teaching and learning with their roles extending well beyond their initial subject or area of specialism. They are providing advice and guidance to other teachers, supporting NQTs, and playing an increasing role in aspects of school management including staff and development."

32. Further evaluation is planned for next year.

Products and Services for Science Teachers' CPD

33. We accept and are actively fulfilling the report's recommendation that we need to ensure that all schools and teachers have the ability to exploit fully the potential of the National Grid for Learning (NGfL). With the launch of the NGfL in 1998, we embarked on the biggest ever programme of investment in schools' Information and Communication Technology (ICT). The NGfL provides teachers with a gateway to an increasing range of information and appropriate, quality assured educational resources on the Internet. ICT literate teachers are key to the successful implementation of the NGfL in the classroom and measures exist to ensure that where necessary, teachers have the opportunity to develop their levels of competence and confidence.

ICT training for teachers

34. With the introduction of the NGfL, it has become even more important for newly qualified teachers (NQTs) to be confident and competent in using ICT effectively in their teaching. The initial teacher training (ITT) National Curriculum for ICT was introduced in September 1998 to ensure that all trainee teachers understand how to make maximum benefit of ICT in teaching all subjects. It also forms the basis of the Lottery-funded training for serving teachers in the use of ICT.

35. Teachers must be able to decide when the use of ICT is beneficial to achieve teaching objectives in the subject and phase, and when the use of ICT would be less effective or inappropriate. The ITT National Curriculum for ICT covers how trainees can take account of ICT and the ways it can be used by teachers in achieving subject teaching and learning objectives.

36. A computerised skills test in ICT will be introduced from September 2001 for all trainee teachers expecting to gain Qualified Teacher Status from 1 May 2002. All trainees are required to take the tests, irrespective of the subject and age phase they are specialising in. The ICT test will cover the core skills needed to fulfil a wider role in school, rather than the subject knowledge required for teaching. Test questions will be put in the context of the professional role of a teacher.

37. Circular 4/98 "Teaching: High Status, High Standards' sets out the requirements for all courses of initial teacher training (ITT), including the ITT National Curriculum for ICT. The Teacher Training Agency (TTA) published proposals in December 1999 for a review of Circular 4/98, which includes a lengthy and detailed consultation process with interested parties. The TTA will provide Ministers with an interim report in December 2000. The revised Circular will be published in early 2002 and come into effect from September 2002. The overall aim of the review is to streamline the requirements of ITT and reduce the bureaucracy in the present arrangements, without compromising the quality associated with the Qualified Teacher Status standard.

38. Through the New Opportunities Fund (NOF), £230 million has been made available to offer high quality ICT training to serving teachers. The training outcomes are based on the ITT National Curriculum in the use of ICT in subject teaching. At the end of July 2000 over 140,000 teachers had registered for training, and many more continue to do so. Of these, 40,000 have already completed the programme.

Access to ICT

39. £657 million is being made available to LEAs through the Standards Fund between 1998 to 2002 to build an infrastructure which ensures quality access for students and teachers and enables effective links with the Internet as well as access to educationally valuable content. The Prime Minister recently announced that a further £710 million of expenditure would be supported between 2002 and 2004. Our target is for all schools to be connected to the Internet by 2002. Currently 98 per cent secondary and 86 per cent primary schools are connected compared to 83 per cent and 17 per cent in 1998.

40. Some 28,000 teachers have had the purchase of a computer subsidised by the Department through the Computers for Teachers initiative.

Content of the NGfL

41. NGfL provides a wide range of online content including resources dedicated to science teaching and to professional development.

42. TeacherNet is our new gateway to professional resources for teachers and provides a single point of access to official information online and easy to use navigation facilities. It aims to provide the information and facilities teachers want in the form they find useful. From January we will be offering a single registration system across TeacherNet, the Virtual Teacher Centre and the National Curriculum websites, which will allow us to offer people the option of customising the sites they enter to highlight relevant information and services. We will also be closely examining the range of support we currently provide to ensure that teachers have the online tools necessary for them to manage their careers and do their jobs effectively.

43. The Virtual Teacher Centre provides a range of services for teachers including subject hubs and a contributory database. January 2001 will see the launch of a revamped Virtual Teacher Centre with an enhanced search engine and the opportunity to receive e-mail updates of new content and services customised to individual needs.

44. The Science Curriculum Area of the Virtual Teacher Centre is designed to provide information and resources to support science teachers in every aspect of their professional life. It is divided into:

- Subject resources: links to web sites that have been approved as having useful curriculum content.
- The Curriculum: direct links to the National Curriculum documents, schemes of work and frameworks for teaching for science.
- ICT Support information advice, case studies and resources for using ICT in science.
- Tests and Exams: links to the on-line examination syllabuses for science along with Standard Assessment Tests (SATs) information and support.
- Organisations: links to subject associations, national projects and other science-related bodies.
- Discussion Groups: provides the opportunity to communicate, discuss and share ideas with other science teachers.

45. The Contributory Database, also part of the Virtual Teacher Centre, is designed to help teachers develop and share ideas for activities and resources. Contributions, 20 per cent of which relate to science teaching, are many and varied. They range from simple ideas and questions to complete lesson plans and schemes of work.

Quality assurance of development products and services

46. The quality of development opportunities is crucial. We will be publishing, in early 2001, a Code of Practice for training providers which sets out quality criteria for their work with schools and teachers. This will help teachers to make discerning choices when selecting those providing development activities.

47. All resources linked to the Virtual Teacher Centre are quality assured. Teachers Evaluating Educational Multimedia (TEEM) undertake in-depth peer evaluations of off-line and on-line products for school use, and the Parents Information Network (PIN) carry out evaluations from the home market perspective.

Supply Arrangements

48. We are aware of the vast range of curriculum support materials available to science teachers, as highlighted by the Council's report, and are actively considering how coherence could be introduced into this area.

49. We are funding the Chemical Manufacturing and Processing National Training Organisation in the development of their education strategy. They are mapping the involvement of a wide range of organisations with school science, including the production of curriculum materials. They will use this information to create both an information database and a matrix, which will illustrate the range of educational activities taking place and the gaps in provision. This information will be useful to both teachers and suppliers of educational materials.

Centre of Excellence

50. As demonstrated above, we are actively promoting a range of policies to create an environment of continuing professional development in schools. Within this we recognise the need to provide a single point of contact targeted specifically at science teachers where the separate initiatives could be clearly illustrated within a scientific context, opportunities for professional development highlighted and good practice exemplified.

51. The Council's report recommends that we establish a centre of excellence for science teaching and suggests how such a body could operate. We will be commissioning a feasibility study jointly with the Office of Science and Technology to look at this recommendation in more detail.

Annex A

Science Education in Schools

Extract from the Government Response to the House of Lords Select Committee on Science and Technology, 3rd Report (1999–2000): *Science and Society* [*Not Printed*]

Annex B

Science Year

On 28 June, we announced that Science Year would be launched in September 2001. The Department for Education and Employment is leading on this initiative and is working closely with colleagues in the Department of Trade and Industry, including the Office of Science and Technology, and the Department of Culture, Media and Sport. We invited organisations to tender for the delivery of Science Year and the National Endowment for Science, Technology and the Arts (NESTA) is our preferred bidder.

The Year will be targeted primarily at 10–19 year olds and the key people who teach, advise and support them. The objectives of the Year are to:

- raise public awareness and understanding of science;
- promote the idea that science is fun and relevant to everyday life;
- increase pupil engagement in science subjects and increase the take-up of science in further study and career options;
- engage and involve the science community in the Science Year as positive advocates for the Government and for the year;
- strengthen links between schools, industry and higher education institutions; and
- celebrate achievements in science and identify role models—especially for girls and ethnic minorities.

We want the Year to have a sustainable impact and to achieve this we will need to work with key stakeholders, including science teachers. On 16 January we will be holding an Ideas Conference to bring together a wide range of stakeholders and to discuss how we can work together to make the Year a success.

Annex C

Recruitment of Science Teachers

Most science teachers qualify by taking a postgraduate course of initial teacher training. In 1999–2000 there was a 4 per cent rise in the number of graduates training to be science teachers, followed by a further 3 per cent increase in 2000–01. In a buoyant graduate labour market, this is good progress after several successive years of decline. We will be increasing the number places for science trainees available in 2001–02 by 4 per cent compared to the target for 2000–01 from 2690 to 2810.

These increases followed the introduction of new initiatives to promote teacher recruitment, especially in shortage subjects. In 1999–2000, recruits to postgraduate training for science and maths received a £5,000 "Golden Hello" from the Department, £2,500 during training and a further £2,500 on appointment to a relevant teaching post. From September 2000, this scheme has been superseded. Postgraduate trainee teachers in all subjects now receive a £6,000 training salary. Those who qualify in the shortage subjects of science, maths, modern languages and technology will receive a further £4,000 when they successfully complete induction.

In addition, we are strengthening the employment-based training options. Schools employing trainees on the Graduate Teacher Programme now receive grants of up to £13,000 in a full year in respect of each trainee, effectively making the trainees supernumerary. This programme allows graduates to qualify as teachers while working in the classroom. It has proved especially helpful to schools with hard-to-fill vacancies and for mature trainees who are career-changers. There are 1,680 places available on the programme this year—double the number that were available in 1999–2000. Applicants in the shortage subjects, including science, receive priority for funding.

To make it easier for people to complete teacher training, some providers are now offering flexible courses. The new flexible arrangements will enable trainees to receive high quality individualised training that matches their needs and circumstances. The training and assessment will be broken up into flexible modules allowing the trainee to negotiate the best time to complete the training. Training may be undertaken in the evening or weekends, via distance learning packages or an intensive full-time programme over a short time.

Memorandum by Professor Julia Higgins CBE, FRS, FREng on behalf of the Council for Science and Technology

Introduction

I am pleased to submit this memorandum to the Committee for the purposes of its follow-up inquiry into our March 2000 report on supporting and developing the profession of science teaching in primary and secondary schools.

2. To assist the Committee, the memorandum summarises the present position and the key points about our report which remained to be addressed. Particularly over the past 12 months, there have been a number of significant policy and other developments.

3. We very much appreciated the Committee's references to our work in its own report on Science and Society, and are most grateful to members of the Committee for their continuing interest.

Summary of Progress

4. Since we started work over two years ago, the Government has taken a number of very significant and major steps forward in developing and implementing its policies for raising school standards and effectiveness, for supporting the teaching profession and, more especially, for making science in schools even better.

5. At the general level, these steps include the literacy and numeracy initiatives in primary schools; the National Grid for Learning; the new initiative at Key stage 3 covering literacy, numeracy, science and IT; the revised national curriculum; the new post-16 curriculum; education action zones; education business partnerships; specialist schools; beacon schools; and advanced skills teachers.

6. As for science more specifically, they further comprise new financial incentives for attracting graduates into the science teaching profession; new schemes of work for science at Key stages 1, 2 and 3; a further review of the national science curriculum by the Qualifications and Curriculum Authority (QCA) to ensure that it meets the needs of the 21st century; and the agenda for better science in schools which was contained in the White Paper on Science and Innovation (July 2000).

7. In this White Paper, the Government recognised the vital importance of school science in underpinning its more general policies for supporting the nation's prosperity and well being. It undertook specifically to work with us and with science teachers in considering further steps to support their professional development, including those recommended in our report. Since then:

- the pilot phase of the new initiative on science at Key stage 3 has started;
- preparatory work has commenced on Science Year 2001;
- the National College for School leadership including its virtual on-line arm has opened;
- the General Teaching Council (GTC) has come into being, with teachers' continuous professional development (CPD) high on its agenda;
- new performance management arrangements have been introduced into schools for reviewing and appraising teachers annually; and
- the Department for Education and Employment (DfEE) has continued its work on a new, national strategy for CPD with a view to launching this in early 2001.

8. This work by the DfEE included a consultation conference about our report with secondary science teachers. It was held on 1 November 2000 in partnership with ourselves, the GTC and the Association for Science Education (ASE), and some 100 secondary school teachers attended despite severe weather and transport disruptions. A record of the very positive and constructive conclusions is being prepared for publication shortly and for use in follow-up work over the coming months.

9. At the Council's most recent meeting on 4 December 2000, we took stock of our recommendations in the light of a position paper from the DfEE. The paper helpfully outlined the Department's initial thinking on our recommendations numbered 11–13 concerning CPD products and services and "a centre of excellence" for science teachers. It was agreed that these merited fuller consideration and investigation through a feasibility and definitional study.

10. Accordingly, and because of changes in its membership last Spring, the Council established a fresh sub-group of members comprising me and my colleagues Dr Rob Margetts, Sir Paul Nurse, Professor Peter Schuddeboom and Professor David VandeLinde. The work plan and arrangements for the study have yet to be established by the DfEE and the Office for Science and Technology (OST).

Key Points

(i) *Our Report*

11. The report is essentially about broadening and deepening the knowledge and skills of primary and secondary school teachers of the science subjects (substantive and syntactic) which they teach and how to teach these subjects (subject related pedagogy). The performance of school science in terms of pupils' achievements, understanding and interests hinges on this particular set of professional knowledge and skills.

12. We sought to compile an overall picture of the present situation by reviewing published research and other information. For instance, just how good is the existing state of science teachers' subject knowledge, how much secondary school science is being taught by teachers without an A-level or first degree in one or other of the three principal subjects involved, and how effective is the present professional development and training of science teachers?

13. We found one paper about exemplary science teachers knowing less than they believe is the case when teaching outside their subject specialism, and another on the deployment of science teachers in teaching science subjects within and outside their principal subject qualification at Key stage 4. No longitudinal or other comprehensive studies appear to have been conducted into science teachers' CPD. Additionally, our review revealed little, if anything, on:

- the amount, balance and value for money of public expenditure on science teachers CPD at present;
- the standards of science teaching in schools, post 16;
- the experiences, and hence development needs, of newly qualified science teachers in the early years of their careers in the light of their initial teacher training and first, induction year in a school;
- what constitutes effective professional development of science teachers including on-line learning;
- the extra-mural or outreach activities of the new, and yet to be fully established cadre of beacon schools and advanced skills teachers; and
- the view and requirements of teachers concerning the as yet uncompleted National Grid for Learning, which was launched in 1998 with a major investment in schools' information and communication technology (ICT) and in training teachers to use it.

14. Nonetheless from this review and our survey, we did gain a clear and robustly based picture of the twin over-arching requirements, namely:

(a) in terms of policy, to transform the prevailing ethos, culture and practice in schools such that subject related classroom based CPD is endemic, and

(b) in terms of the teachers themselves, to create an organised, pro-active system that actually encourages and enables their subject-related, classroom-based CPD to happen effectively and efficiently.

15. In preparing the report, we sought to build on the existing and developing cornerstones of policy in a forward-looking way, not least with regard to the number and quality of science teachers in schools in the future. More than half the profession is already over 40 years old and some 25 per cent of its members are due to retire within the next 10 years.

16. We took into account that:

- There has been a significant improvement in primary school science, judged by SAT results in key stages 1 and 2.
- Initial Teacher (PGCE) Training, lasting some 34 weeks and occurring mostly in schools, does not cater for any significant broadening and deepening of graduate students' knowledge of science subjects.
- So far, a relatively small proportion of schools have been awarded the Investor in People (IiP) standard. By March 2000, 11 per cent of schools (2,880) in England had secured this standard and a further 22 per cent (5,595) had made a commitment to achieve it.
- Of the some 40,000 science teachers in grant maintained secondary schools in England, some 25 per cent are members of the ASE but only around half of these members make any significant use of its services.

- Around 2,900 new science teachers start their professional lives in these schools each year and some 30–40 per cent of these new entrants quit the profession before reaching their fifth year.
- Unlike some other professions, there is not a framework of professionally recognised and accredited qualifications such that newly qualified science teachers can build up their individual "career portfolios" specifically as science teachers. At present there is only a national standards framework for all teachers covering in general terms such stages of career progression as induction, performance threshold and Advanced Skills Teacher;
- Unlike in many other countries, there is no national regulatory or quality assurance regime that covers the textbooks and like materials which schools in England may choose to use in teaching science. At present, the DfEE is developing a code of practice for training providers and all resources that are linked to the Virtual Teacher Centre of the National Grid for Learning are quality assured through peer review; and
- Beacon Schools and Advanced Skills Teachers are being established to raise school standards by sharing and spreading good practice.

17. We also took account of the general and science specific aspects of science teachers' CPD, as well as:

- the human factors of visionary leadership, ownership, aspiration, motivation, encouragement and recognition which are at least as important as the processes and means by which CPD is conducted and supported; and
- organisational considerations such as coherence, co-ordination, co-operation and communication.

(ii) *Our Recommendations*

18. These fall into two groups. The first, numbers 1 to 10, are of general applicability. The second, numbers 11 to 14, are specifically about science teachers' CPD. All of them concern matters that we consider to be essential if the necessary change is to be achieved, such that science teachers and particularly those in secondary schools, undertake effective, subject-related, classroom-based CPD throughout their careers.

19. Simply expressed, we do not believe that this change will happen unless:

- The governors, head teachers, line managers and staff in each school have the drive, leadership, capacity and capabilities to carry out science teachers' CPD effectively.
- They are served efficiently and effectively by a nation wide system that provides the CPD products and services which their science teaching staff actually need in a form and at a time when they want it.

There is still a long way to go on both these fronts. Action on one without the other will not secure this change alone but setting up the nation wide system will assist the first.

20. The principles of our first, general group of recommendations, covering the Government's new framework for teachers' CPD and the leadership, accountability and school management aspects, tally closely with DfEE's most recent (February 2000) consultation document.

21. In our view, the new CPD strategy, which is now being prepared by the DfEE for publication, will need to be much more than a statement of principles and aspirations. It must address clearly the crucial question of how and why it will secure "buy in" from teachers and the main levers by which this is to be secured in practice.

22. Strong, effective, sustained leadership within the science teaching profession as a whole and at all levels of line management will be essential. The provision of sufficient time and other resources for head teachers and their senior staff to introduce and deal successfully with the new performance management arrangements is also vital.

23. These points were emphasised by the teachers who attended the consultation conference on 1 November 2000. The teachers also stressed the related considerations concerning the provision of adequate training, advice, guidance, support and benchmarks.

24. The second, integral group of science specific recommendations 11 to 14 set out in broad, conceptual terms the essential features of the organised, teacher-led, teacher-friendly pro-active system. They cover a "core-set" of CPD products and services, supply arrangements and what we called for convenience a "centre of excellence for science teachers".

25. We adopted the phrase "centre of excellence for science teachers" to express the essence of our ideas about its role and purposes in a simple, memorable way, namely that such a centre should lie at the heart of all science teachers' CPD. It would serve and meet the vital, strategic purposes of:

- Catalysing and driving the process of change throughout the profession of science teachers, not just the membership of the ASE.
- Achieving coherence, co-ordination and communication at the national level, particularly with the supply side of the CPD market.
- Enabling innovation and experimentation in science teachers' CPD and teaching.

- Ensuring that the profession's present and future requirements for CPD products and services are actually met.
- Helping the profession to improve continuously by keeping its CPD activities under systematic review and evaluation.

26. Since this group of recommendations are subject to further investigation, we did not present any views on the questions of how the "centre" should be best established and organised with a national wide, uniform reach, or what products and services should fall within its remit. But the online (virtual) arm of the National College for School Leadership was the sort of model we had in mind. This comprises an expert team of facilitators, acting as helpers, advisers, coaches, mentors, tutors and managers to groups of (ICT linked) school leaders.

27. As for recommendation 11 concerning a "core" set of CPD products and services, the planned definitional and evaluation work could possibly draw on the results of the pilot stage of the new Key stage 3 science initiative, and the new performance management arrangements. Other possibly useful reference sources include:

- the career entry profiles which newly qualified teachers receive at the end of their initial training;
- the ASE's new two year professional development programme which is targeted at science teachers in the first two to eight years of their career and is being supported by the DfEE and the Teacher Training Agency;
- the GTC's work and consultations on teachers' CPD; and
- the TeacherNet and the Virtual Teacher Centre parts of the National Grid for Learning, which provide online resources dedicated to science teachers and to professional development.

28. More generally, the investigative work ahead will need to address and resolve questions of funding, affordability and value for money. With these financial considerations in mind, we focused our recommendations on the relatively small population of secondary school science teachers who are in the first five years of their careers. In England, they number around 10,000 at present, compared with a total of some 40,000 secondary school teachers, or the far larger number of over 200,000 teachers who are teaching science in primary and secondary schools.

CONCLUSIONS

29. I was first asked by my Council colleagues to lead this work in the autumn of 1998. Since then, significant changes have occurred in policy terms. It will be some years yet before the full effects and benefits of all the measures for improving school science education become apparent from all viewpoints. Much will depend on the detail in the formulation and execution of these policies, as well as their operation once implemented.

30. In my view, these changes amount to a very welcome agenda for putting a real sparkle into school science and school science teachers. I am now looking forward to the further investigative work on our centre of excellence and related proposals for helping and supporting science teachers' subject-related, classroom-based CPD. And I should like to see this work completed so that these proposals are put into effect and become an enduring legacy beyond Science Year 2001.

Julia Higgins
Council for Science and Technology

December 2000

Memorandum by the Institute of Physics

The Institute is most grateful for the Sub-Committee's invitation to submit evidence to its current inquiry into Science in Schools. There is plenty to praise about the achievements that have been made in the past decade, most notably with regard to science in primary schools, but there are also causes for concern.

PRINCIPAL CONCERNS

The number of students choosing to study physics post-16 and to continue with their studies of the subject in higher education is insufficient to sustain the demand for the physics (and engineering) graduates needed across the whole field of employment. Consequently the nation's economic health and well being is threatened. The introduction of *Science for All* to age 16 in the 1980s was a welcome development as it provided, in principle, a broad base of scientific awareness for the whole school population and prevented young people from closing down study opportunities in science and technology at the age of 14, particularly with regard to girls and physics. However, compulsion does not necessarily lead to achievement, enjoyment or even engagement and *Science for All* has not reversed the relative decline in the numbers of those choosing to specialise in the physical sciences post-16. There are those, including members of the Institute, who question whether we have the right sort of *Science for All* both with regard to those who will finish their science studies at age 16 and for those who continue their studies beyond 16.

The learning experience of pupils pre-16 is the key factor in determining subject choices post-16, and is itself determined by the nature of the teaching programme and the quality, effectiveness and enthusiasm of the teacher—in whatever subject area. The difficulties facing physics teacher recruitment and retention have a very deleterious effect on teaching the subject pre-16 and are thus of the greatest concern to the Institute of Physics.

The Institute has pointed out over many decades the scale and consequences of the shortage of trained physicists in schools. It was the first to highlight the trend (referred to by Lord Sainsbury in the House of Lords dinner debate on the White Paper, *Excellence and Opportunity*[1]) for physics to be taught by non-specialists and did so long before double award science was introduced.

In recent years of the order of 200 physics graduates only have entered teaching each year, compared with more than three times that number a decade ago. This trend, and that of young physics teachers leaving the profession, can be reversed only by re-establishing teaching as a profession of esteem with recognised career progression pathways, and with working conditions, job satisfaction and financial rewards comparable to those offered to physics graduates in other employment areas. Entitlement to appropriate continuing professional development is essential in this respect.

Government

The Institute was pleased to note the importance placed by the Department of Trade and Industry's White Paper *Excellence and Opportunity* (Cm 4814 July 2000) on better science in schools. In particular the emphasis on teacher retention and recruitment is most welcome.

The Department for Education and Employment has responded positively to many of the key difficulties facing teaching, and science teaching in particular. Through its initiatives and the work of its agencies—OfSTED, TTA and QCA—the need for improved quality of science teaching in schools is being acknowledged. The Institute welcomes these initiatives. However, there is a concern that their apparently disaggregated nature could lead to a lack of cohesiveness. The TTA is responsible for recruitment and initial training, DfEE responsible for CPD, and the QCA involved in reviewing the curriculum and its assessment. OfSTED monitors what happens in schools, but is not directly involved in any remediation process. All of these initiatives impact on teachers' professional life, but not necessarily in mutually supportive ways.

Students, the Curriculum and the Learning Experience

Particular attention is needed to the 11–14 (Key Stage 3) phase of science education, acknowledged as the "Cinderella phase". There is evidence, in the science area in particular, that many students do not progress in their learning as they should. KS3 is a stage with no "qualifying" examinations and thus in times of limited funding less material resources are devoted to this stage. With regard to physics, it is the stage during which the physics elements of the science curriculum are least likely to be taught by those who have both depth and breadth of knowledge of the subject.

The new Key Stage 3 (KS3) Science Strategy aims to identify more closely the issues affecting the teaching of science at this level and to develop resources to improve practice. It having been acknowledged that in this area the system is starting from a low base of appropriately qualified (physical) science teachers, it is important in-service provision to address the "deficiencies" is adequate for the purpose, and that the materials developed and support systems put in place are of the highest quality.

There may be a case for a similar exercise relating to science at Key Stage 4 in due time, but there are wider issues that need to be addressed about the structure of the curriculum post-14 and the place of the sciences within it. There are also issues that need to be resolved about the purpose and focus of secondary school science at this level—the preparation of young people as informed citizens in a world dominated by science and technology with their associated societal and ethical implications, and/or the preparation of future professional scientists, technologists and engineers. These issues could also have implications for the education of future teachers of physics/science.

Recruitment of Physics Teachers

The Institute believes that there are special issues arising in the case of physics and physicists, and their role in schools. Articulation of these may help to clarify the issues and thus provide some pointers to solving the problems of recruitment and retention more generally.

As indicated above, physicists are much sought after by employers, often at substantially higher salaries than offered in the education sector. Even when starting salaries are comparable, limits to mid-career salaries and career progression in teaching may be off-putting to potential new entrants to the profession. The growth of employment by physicists in other sectors—especially commerce—is making matters more critical for teaching. There is no problem of unemployment for undergraduate physicists.

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[1] House of Lords Debates, 11 October 2000, column 421.

Graduate physicists who remain in physics are more attracted to those jobs where they can fully use and develop their physics skills and knowledge. Teaching across the sciences, as is the norm in schools, is not attractive to all of them.

The attraction and availability of other career paths for physics graduates means that, on average there are less high-fliers entering teaching than would be found in other disciplines, but this is not to suggest that there is a direct correlation between high fliers in physics and the optimum teaching of the subject in schools.

Physics is a fast developing subject, both in its underlying science and in its applications. It is difficult for any physicist, wherever s/he is employed, to remain up to date.

The Institute has outlined a series of actions for addressing the shortfall in the new entrants to teaching. Its proposals are attached in tabulated form.

Teachers and Continuing Professional Development

Teachers lie at the heart of a system of competing pressures. There is now a substantially higher administrative burden on teachers, less discretion in teaching content and methodology and a more complex relationship between all stakeholders in compulsory education (parents, students, teachers, heads, governors, education authorities, standards bodies and government). The Institute fears that, as a result, many teachers perceive erosion in their independence and authority. Current research into Teacher Supply and Retention supports this view, with evidence to suggest that the ways in which teaching has been managed, "accountable" and subject to control and direction have contributed to demotivation.

The need to persuade a higher proportion of graduates to enter teaching has already been argued. To give job satisfaction to those who do enter the profession, to keep their teaching of science (both content and approach) up to date and to offer development opportunities comparable to those enjoyed in other areas of employment, more resources (money and time) must be invested in the continuing professional development. CPD must be seen as an investment in the improvement of the learning experiences of the students, teaching standards, and in the retention of teachers.

It is arguable that the present interpretation of professional development is too narrow, in terms of how it may be achieved. Headteachers face difficulties in balancing the needs of schools, departments and individual teachers while providing INSET cost-effectively. Whereas there is a place for INSET to be provided electronically (by distance learning), the Institute's experience in running "traditional" out-of-school INSET for teachers who lack confidence in teaching physics is that they gain greatly from the confidence they develop through face-to-face interaction with the tutors and with their peers. It is true that CPD can be achieved in the classroom context through observation and support by an expert. However, given the shortage of physics teachers, it is often the case that this cannot be provided by departmental colleagues.

The nature of CPD must be matched to both the needs of the school (pupils) and the needs of individual teachers. Within the emerging structures for continuing professional development, the Institute questions whether there is enough emphasis given to the different needs in different subject areas, and the differing needs of teachers within a subject area. It is important that headteachers are aware of these and manage them accordingly.

As physics advances not only must teachers of physics be kept up-to-date in terms of these advances but also in terms of how subject is presented to young people in school. Practising teachers were crucial to the development of the Institute's new *Advancing Physics* scheme, both as initiators of new ideas, writers, question writers and evaluators. Not only has the product been very well received and motivating to teachers and students, but the process of involving teachers has greatly increased their expertise and their self-esteem. There is a need for a system whereby this form of professional development can be validated and thus valued.

Given the necessary diversity of provision of CPD, there is also a need for some "standardisation". There is also a need for the investment in CPD to be audited. Both standardisation and audit can be achieved through validation and accreditation. It is hoped, therefore, that as the General Teaching Council becomes established, it will take a key role in the validation and accreditation.

On a different note, the Institute recognises that to deliver an appropriately broad curriculum in schools with existing resources, teachers need to be able to teach outside their major discipline. Physics teachers are generally required to teach across the sciences at lower secondary level. Yet some potential physics teachers are deterred by the prospect of teaching biology and chemistry while, as alluded to above, they might feel more comfortable teaching mathematics and/or technology—each of which is a teacher-shortage area. Whatever "other subjects" they may be required to teach, it is essential that teachers are appropriately prepared to teach these through initial and in-service education.

Professional Bodies and Learned Societies

Charities and not-for-profit organisations, such as learned societies and professional bodies, have much expertise and good will which may be brought to bear upon topics of public policy concern. In the education area there appear to be many unexplored opportunities for increased partnership between bodies such as the Institute and government (and its agencies).

The Institute of Physics is a leading international professional body and learned society, which promotes the advancement and dissemination of a knowledge of and education in the science of physics, pure and applied. It has over 30,000 members drawn from all sectors—research, higher education, schools, industry and commerce.

The Institute has been hindered in its analysis of the problems of teacher recruitment and retention and thus in the development of remedial plans by its inability to obtain accurate figures on the numbers, qualifications and skills of teachers, disaggregated to a useful level to assess the scale of need by individual discipline. We would urge that Government be asked to collect such data and put them in the public domain.

Through its Education Department (Schools and Colleges), the Institute operates an extensive education programme of support and activities for teachers, educational and careers materials and advice for pupils. It has recently produced a new AS/A2 course *Advancing Physics* (with the OCR Awarding Body) introduced in schools/colleges in September 2000.

The Institute organises two-day Update courses for teachers of physics, with seminars and workshops on issues in physics teaching, talks on new and exciting areas of physics and its application, and opportunities to debate and resolve teachers' questions. Courses are provided both at Post-16 level and at KS 3/4. Some of the latter are have been aimed specifically at chemists and biologists teaching physics, organised in collaboration with the Royal Society of Chemistry and Institute of Biology. These courses are very successful and usually oversubscribed, but only touch a small proportion of the teaching population. The scale required for a national, comprehensive programme would, regrettably, be well beyond the financial resources of the Institute.

Conclusions

The teaching community feels that it is less trusted by government, and regarded as less professional by the public as a result of policy changes over the last twenty years. The Institute sees in the various CPD proposals an opportunity to rebuild, at modest cost, some of the self-esteem and confidence of ordinary science teachers. Teachers must be trusted, in partnership with head-teachers, to determine as much as possible their own training needs. A teacher should be given as much discretion as possible to shape her/his own career progression, be it in management, enhanced subject skills or acquired interdisciplinary skills. In this context we were pleased to hear Estelle Morris speak about the pilot bursary scheme allowing teachers to choose how they spend their money on their own continuing professional development. This move should allow teachers to retain their own professional judgement about what will best meet their needs.

The Institute has referred to salaries as part of the problem of teacher recruitment and retention. The main difficulty relates not so much to starting salaries, which would now appear to be more competitive, but rather to mid-career salaries. New entrants are fully aware of mid-career salaries and limitations to career prospects. The government must continue to devote attention to improving mid-career opportunities. In this respect, the Institute welcomes the government's recent introduction of increased pay for teachers who achieve Threshold status.

As a membership organisation which is developing strongly its networking activities, the Institute is a great believer in the importance of professional social interaction. While new technologies have much to offer, the Institute believes that face to face communication and discussion will be of increasing importance in future.

In the broader area of science in schools, there are those within the Institute who are beginning to raise the question, touched upon in the first meeting of the Inquiry Sub-Committee, of whether the current national curriculum provides effectively for the needs either of the scientifically literate citizen or the future physics innovator? Can the education of the former also provide appropriately for the latter? This is a particularly challenging idea and one which the Institute hopes will also be addressed by the government.

Peter Cooper
Director, Science

A STRATEGY TO ENCOURAGE TEACHER RECRUITMENT IN THE PHYSICAL SCIENCES

	Target Groups					
Objective	*Undergraduates*	*Postgraduates*	*Mid-career—academe*	*Mid-career—industry*	*School Heads and Governors*	*Notes*
Provide information designed for physical scientists	Produce subject-specific materials (printed and electronic) aimed at physicists, chemists and engineers, outlining the opportunities for them and the particular way their skills and knowledge will be used as a teacher, together with the various entry routes and salary scales					IOP/RSC to assist in writing the material and dissemination/put on websites etc. TTA to fund and distribute further
Increase access to information	University physics and chemistry departments to have a "Teaching—the facts" on their websites, linked to TTA/IOP/RSC pages					IOP/RSC to encourage via Standing Conference of Physics Professors (SCPP)/ Higher Education Chemistry Conference (HECC)
Extend undergraduates' true knowledge of careers in teaching	Letters, emails and seminars on teaching facts and opportunities					IOP/RSC/ASE to organise/ franchise seminars to universities, subject to funding
Extend potential mature entrants' true knowledge of careers in teaching			Produce leaflets/Web information with case studies showing mid-career entrants into teaching. Circulate to employers and personnel departments. Replicate "Thinking of teaching?" seminars for engineers.		Produce guide on the benefits of mature entrants with industrial or research experience	IOP/RSC/ASE to assist in preparing case studies etc. and disseminating to members. TTA to fund and distribute further
Extend opportunites for students and others to experience the school environment	University physics and chemistry departments to have extra-curricular schemes to enable students to spend time in schools as classroom assistants. Produce a good practice guide for departments		Provide information on "taster" courses, in print and via Web. Provide information on arranging a "taster" at a local school.		Produce guide to using classroom assistants. Produce guide on laying on "taster" sessions	IOP/RSC/ASE to assist in preparing materials and disseminating to members. TTA to fund and distribute further
Extend opportunites for students to experience the school environment	Provide paid placements in schools for year 3/4 physics/chemistry undergraduates (cf industrial placements)					IOP/RSC to encourage via SCPP/HECC. Influence via DfEE
Remove disincentives for researchers and postdocs to engage with schools			Encourage HEFCE to give recognition in RAE to school-related activity by researchers			IOP/RSC to encourage via direct approaches. Influence via DfEE
Minimise disincentives of further training after graduation	Combine final year of 4-year MPhys/MChem with gaining part-qualification in teaching	Combine PhD study with gaining teaching qualification				IOP/RSC to encourage via SCPP/HECC and links with Research Councils. Influence HEFCE via DfEE
Remove financial disadvantage when starting teacher training		Instigate higher/ differential bursaries for postdocs	Address levels of salaries for mature entrants, reflecting previous experience, skills and knowledge to make entry into teaching a realistic career option			Influence via DfEE

Memorandum by the National Association of Schoolmasters Union of Women Teachers

1. NASUWT welcomes the opportunity to provide a submission to the Committee on the issue of Science in Schools.

2. As background to the submission, NASUWT wishes to refer to the Council for Technology Report on Science Teachers. Paragraph 1 states that "The report addresses the question of what would make a material difference in helping science teachers in primary and secondary schools develop and improve their professional practice, individually and collectively."

3. However, the report appears to concentrate largely upon continuing professional development to the extent that other equally important areas are excluded.

4. Other factors which would make a material difference to the teaching of science are as follows:

(a) Improvements in accommodation

— Too many classes at both primary and secondary levels are taught in non-specialist rooms without access to electricity, gas or water;

(b) Access to support from technicians

— NASUWT asserts that there should be a minimum entitlement to technician support at both Key stage 2 and the secondary phase of education;

(c) A reduction in class size

— In secondary schools the quality of learning, particularly experimental work and information Communication Technology, would be significantly improved if laboratory classes were reduced. In addition, much of the science work at Key stages 1 and 2 is of a practical nature. Notwithstanding the difficulties in providing effective practical science education with classes of 30 or more there are serious implications in relation to health and safety;

(d) Improvements in the training of specialist teachers

— There is a compelling need to staff schools with specialist teachers. In the secondary sector huge improvements in the quality of teaching and learning could be achieved if science teachers were able to concentrate on their area of expertise. Sadly, too many pupils are being taught physics by teachers of biology, biology by chemistry specialists and so on. If it is not possible to initially train physics and chemistry teachers then, at the very least, the re-training of those who teach outside of their specialism should be a priority. Such training needs to be comprehensive and with a minimum entitlement. Moreover, many science co-ordinators and class teachers in primary schools are not specialists in the subject. Training is carried out frequently through the cascade model, which has proved consistently to be ineffective.

5. On the issue of Continuing Professional Development NASUWT wishes to make the following points:

— it should be financed centrally and allow for a minimum entitlement;

— it should be funded fully to enable teachers to access this during working time. Provision must be made for the purchase of supply cover;

— it should not be delivered by the cascade model; and

— it should be focused on subject specialism for secondary teachers.

NASUWT

January 2001

Memorandum by the National Union of Teachers

1. The National Union of Teachers welcomes the opportunity to make a contribution to the Inquiry into Science in Schools.

The Report of the Council for Science and Technology: *Science Teachers*

2. The NUT welcomes the contributions of the CST to a discussion on supporting and developing continuing professional development (CPD) for science teachers. It particularly welcomes the fact that the CST has sought to base its recommendations on research evidence, including surveys of the views and attitudes of teachers themselves.

3. The NUT is committed to the principle of effective CPD for all teachers as an entitlement, including as an effective means of contributing to the development of subject teaching. The NUT would wish to emphasise its view, however, that the quality of teaching and learning in science is influenced by factors other than the availability of effective CPD.

4. Issues of class size—in particular where live demonstrations are taking place—levels of technical support , and the organisation of the National Curriculum and National Curriculum Assessment will all have

an impact on the effectiveness of teaching and learning in science. Wider external factors, such as the socio-economic profile of the pupil population of a school or the ability of schools to successfully recruit and retrain teachers will also have a significant impact.

5. The NUT would regard many of the recommendations and observations made in the report with regard to CPD to be equally true of teachers in any subject discipline. However, it notes that the issue of CPD for teachers in subjects other than science is outside the remits both of the CST and the Select Committee.

6. In order for CPD in science to be effective it is necessary to ensure that CPD programmes:

- allow teachers to keep up to date with developments in the sciences;
- are designed with due consideration to the views of teachers of science in primary and secondary schools as to the areas where they would most benefit from developments; and
- are made accessible to all teachers with full account taken of equality of opportunity to access. This would normally mean that CPD would take place during school hours or in directed time.

7. It is important to ensure that any future development of the arrangements for CPD for science teachers can be supported in terms of providing appropriate cover arrangements for teachers who are absent in order to pursue CPD programmes. It would also be necessary to establish an entitlement for all teachers in a school science department to access CPD while also ensuring that the department is able to maintain a full programme of study in science for pupils while this CPD is taking place.

8. The NUT notes that a number of recommendations and observations in the report focus on teachers in secondary schools. It would urge the CST and the Select Committee to remain aware that science between the ages of 5 and 11 represents a considerable proportion of a pupil's overall entitlement to science education within the National Curriculum. The importance of teaching and learning in science in primary schools should therefore not be underestimated.

9. The Select Committee should be aware that teachers of science in primary schools—potentially including science coordinators—are not necessarily science specialists as would be the case in a secondary school. The provision of effective and appropriate subject based CPD in primary schools, and in particular for subject coordinators, is therefore as important an issue in primary schools as for secondary schools.

10. The NUT would urge the Select Committee to pay specific attention to the view expressed in the report that products and services for CPD "must be 'teacher designed' and be easy for teachers to access, use and apply."

11. The NUT would agree emphatically with the statements in paragraph 41 of the report that "individual CPD must be long term and classroom focused" and in paragraph 42 that it should involve teachers "individually and collectively" with the objective that teachers will "be able to contribute to the development of the professional practice of science teaching itself." Such views correspond with the way in which the NUT has sought to develop its own programme of professional development services to its members.

12. The NUT welcomes the findings of the report, in paragraph 59, that "more money is undoubtedly needed . . . [and] the main constraints on science teachers' CPD are time, money, workload and fatigue, along with the lost opportunity costs involved in arranging supply cover to attend external courses" and in paragraph 69 that "all science teachers need 'quality' time to revisit and enhance both their subject knowledge and pedagogy repertoires". These findings reflect views which have been put forward consistently by the NUT in relation to teachers' CPD.

13. The NUT acknowledges the potential for the use of information technology in supporting CPD, but would emphasise that teachers' ability to access such technology is variable, both in terms of the time available for them to do so and their ability to access appropriate IT equipment.

14. The NUT would wish to support the statement in paragraph 107 of the report which seeks to "caution the Government against being over prescriptive as to what should comprise a science teacher's continuing professional development".

Report of the Select Committee on Science and Technology: *Science and Society*

15. The NUT welcomes the acknowledgement in the report of the important contribution made by teachers of science at all levels.

16. The NUT would agree emphatically with the statement in paragraph 6.8 that "in-service support for science teachers . . . should be long term, rather than a one day event; it should give insights into leading-edge research; and it should be directed by the individual teacher rather than imposed from above". The NUT regards these as fundamental principles underlining the most effective CPD for teachers.

17. The NUT is committed to the principle of an entitlement to a broad and balanced curriculum for all pupils. It would therefore share the concerns of the Select Committee with regard to the "squeeze" on curriculum time for certain subjects as the result of the drive for literacy and numeracy, and indeed as the result of an overloaded and over-prescriptive National Curriculum. The NUT would caution against considering the amount of time devoted to science teaching in isolation or in terms relative only to literacy and numeracy.

18. It is vital that schools are able to develop curricula in an holistic way which is able to reflect sufficient teaching time in all subject areas to represent an appropriate entitlement for every child in each subject. The NUT would also emphasise that literacy and numeracy can be developed through the teaching of the range of National Curriculum subjects—including science—and that literacy and numeracy should not necessarily be considered as disciplines to be developed in isolation from the full range of subjects within a schools' curriculum.

19. The NUT welcomes the contribution which the report makes to the debate on possible future developments for the National Curriculum for science. It is vital that any such consideration of the development of the National Curriculum for science takes place within the context of a consideration of the overall curriculum, not least because issues such as developing "science literacy" or "science for citizenship"—as mentioned in the report—have implications beyond the confines of the science curriculum and can be developed within other subjects and curriculum areas. It would be necessary to fully include teachers and their representatives within such discussions, with any curriculum change being teacher led. Within that context, and subject to the "gradual approach" advocated in the report the NUT would welcome a dialogue on the streamlining of the science curriculum in order to meet the needs of all children and young people.

20. The NUT would welcome future investigation into developing opportunities for live demonstration and practical investigative work in classrooms. It is essential that teachers and their representatives are involved as key partners in such development.

Memorandum by the Royal Society of Chemistry

Continuing Professional Development for Science Teachers in Schools

The Government has produced policies on Threshold Assessment and Performance Management and consulted on Continuing Professional Development (CPD) of teachers which, together, could lead to a coherent system for all teachers. The key element is Continuing Professional Development and Performance Management with Threshold Assessment following on from Professional Development. However in the year since the consultation on CPD no coherent policy has appeared but instead the Council for Science and Technology report, the key Stage 3 Strategy for Science and the New Opportunities Fund training for teachers in ICT have all appeared independently and could appear to conflict with each other. What is required is a coherent philosophy for CPD with a uniform delivery across schools and colleges in which science is seen to be an integral part. The needs of teachers as scientists should be satisfied within this framework but at present the framework is not there.

The Royal Society of Chemistry is the largest non-governmental provider of INSET for chemistry teachers and for many years has provided a programme of Industry Study Tours, Hands-on Symposia, Summer Schools for Teachers, and Management Workshops. The Society wishes to continue to provide these training opportunities and would be willing to adapt them to a suitable framework should one exist.

Time Allowed for Science in Primary Schools

There is a perception that the amount of time given over to science in many primary schools has been reduced since the introduction and emphasis on the national literacy and numeracy strategies. Whilst national and international test results do not give cause for concern it appears that these do not reflect the 50 per cent of time that is supposed to be devoted to scientific enquiry (Sc1) rather than the teaching of content (Sc2, Sc3 and Sc4). Whilst the tests can adequately measure the interpretation of data and the recall and application of factual content the lack of time devoted to Sc1 has meant that there is less development of scientific literacy for citizenship and less awareness of the strength and weakness of the scientific method. The understanding of the processes of science is thus necessarily less.

The Royal Society of Chemistry supports science in primary schools and has recently produced a volume entitled *That's Chemistry!* containing background scientific information and experiments, demonstrations and activities for use by primary teachers. The Society is also a major contributor to the STAR project which has produced a resource containing elements of science and literacy. The volume consists of poems on scientific themes by Michael Rosen and associated science and technology activities.

Science Experiments and Health and Safety

The 1974 Health and Safety at Work Act and subsequent legislation has improved the safety climate in schools and colleges and improved both the management and practice of health and safety. Of itself, regulation does not prevent students experiencing good hands-on science although regulation is sometimes cited as reason not to carry out legitimate practical work. The problem is an erroneous interpretation of the regulations and over-stringent enforcement and practice at a local level. In the past 30 years only two commonly used experiments have been removed from the curriculum (both involving the use of benzene). It would be helpful if the DfEE gave a lead in making this clear.

A more recent area of concern is that of the interpretation and application of the regulations applying to waste disposal. Waste is the new fly in the ointment. Waste from science departments in schools and colleges is classified under the Special Waste Regulations. The Society has worked with the Association for Science Education (ASE), the Consortium for Local Education Authority Provision of Science Services (CLEAPSS) and the Scottish Schools Equipment Resource Centre (SSERC) in an attempt to resolve some of the issues concerned with waste disposal and to obtain guidance from DETR. To date this has been without success, but without guidance local solutions may not be consistent and either unsatisfactory practice could prevail or over-stringent application of the regulations could unnecessarily curtail what schools do.

The Royal Society of Chemistry has recognised the need to minimise waste and has produced a book entitled *Microscale Chemistry* which has been sent to all schools and colleges in the UK. As well as producing less waste, microscale experiments can often be carried out in a shorter time and not necessarily in dedicated science facilities.

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